THE OCCURRENCE OF RAPID EYE MOVEMENTS DURING FREE IMAGERY AND DREAM RECALL

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY
Howard H. Morishige

1968

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By

Howard H. Morishige

AN ABSTRACT OF A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1968

ABSTRACT

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By Howard H. Morishige

The purpose of the present study was to determine: (1) whether rapid eye movements (REMs) occurred during dreamlike processes such as free imagery and dream recall or (2) whether REMs were the result of purely neural mechanisms operating as unique characteristics of nocturnal dreaming. This study, through the use of EEG, EOG, and finger pulse monitored while Ss underwent free imagery and a visual recall of a single vivid nocturnal dream, proposed that REMs would occur in the waking state under both experimental conditions.

REM recordings were compared in 10 Ss under free imagery and dream recall conditions. Of the 10 Ss, 9 exhibited REMs during at least one of these conditions. Data for both experimental conditions were treated separately by comparing each with a corresponding resting period as a baseline measure.

Significant results of this study were (1) REMs occurred during both free imagery and dream recall, and (2) a pronounced tendency of alpha suppression during dream recall. The type of REM patterns which occurred

during the waking state in this study differed from reported studies of REM patterns on nocturnal dreams (Stage I-REM) in that waking state REM patterns were lower in amplitude, more gradual in slope, and had a tendency not to occur in clusters. Hence, the above results do not discredit the possibility that Stage I-REMs is a phenomenon unique to nocturnal dreaming.

This study also showed the occurrence of alpha desynchronization only during the dream recall condition but not during free imagery. It was posited that alpha suppression occurring during visual imagery in the waking state was not a specific concomitant of visual imagery, but rather a possible indication of the anxiety producing processes being symbolized by the recalled dream, or even the cognitive task of recalling a previous nocturnal dream. Inspection alone revealed that there was a greater ratio of primary process material when the Ss engaged in visual imagery during dream recall than in free imagery.

The results of this study suggest that primary process visual imagery is a powerful variable that influences the occurrence of REMs, desynchronization of alpha rhythm, and increase of heart rate.

The present study opens avenues for future research in its attempt to explore the role that primary process plays in the relationships between psychological processes such as visual imagery and autonomic arousal such as those monitored by the EEG, EOG, and finger pulse.

Approved: Joseph Reyher
Major Professor

3/14/68
Date

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ACKNOWLEDGEMENTS

The author extends his sincere gratitude to Dr. Joseph Reyher for his continual encouragement and guidance in the planning and completion of this study. As chairman of the committee, he was instrumental in making this research a most stimulating and valuable learning experience.

Grateful acknowledgements are also extended to the other members of the committee, Dr. Norman Abeles and Dr. Paul Bakan, for their interest in this study and their helpful clarifications.

The writer is also indebted to Dr. Albert Ax and Dr. Donald Caldwell, Directors of Psychophysiology and Psychobiology Research, respectively, at the Lafayette Clinic, for their assistance in familiarizing materials dealing with the complicated nuances of polygraph recording. The many courtesies and hours of consultation extended by Dr. Caldwell have been deeply appreciated.

Special thanks is also expressed to Gerald Gilmore of the Computer Center for his assistance and Bruce Burns for his interest and concern. And to Jean Kawazoe and Stephen Morishige, a note of appreciation for their patience in serving as subjects during the planning stages of this study.

To Alyce

For her devotion and continual source of inspiration.

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INTRODUCTION

In the early development of free association Freud requested his patients to close their eyes and report their visual images. He later discontinued this method in favor of eyes open free association which is still a standard procedure in orthodox psychoanalysis. However, since Freud's innovation in his free association technique, visual imagery has been used occasionally by a few psychotherapists (Kubie, 1943; Jellinek, 1949; Goldberger, 1957; Kanzer, 1958; Wolpe, 1958; and Hammer, 1967).

Recently, Reyher (1963) reported that eyes closed free association with an emphasis upon visual images, i.e., free imagery, is a powerful technique in psychotherapy if used properly. Reyher accounts for the use of this procedure as follows:

> The procedures involved in free imagery are designed to minimize secondary process and maximize primary process by eliminating or reducing visual and auditory cues that are necessary for supporting defenses and for maintaining an external frame of reference.... When a client is asked to describe only images, feelings and sensations, he is deprived of cognitive processes and is thrown back upon more subjective media which are easily influenced by unconscious material and primary process. (p. 459)

In undergoing free imagery, the client is induced to experience vivid visual fantasies that are dominated by primary process and which clearly manifest the mechanisms present in "dream work." In free imagery procedure, visual fantasies become so well organized that they differ from dreams only in being less disguised. As in dreams, free imagery can produce repressed wish fulfillments, derivatives of anxiety producing drives, and may be characterized by mechanisms of dream production, such as symbolism.

Until recently, dream research was limited by the lack of a reliable objective method for determining exactly when a patient dreams. However, a method for detection of dream was described by Aserinsky & Kleitman (1955) who reported the occurrence of ocular motility in sleep. Two types of eye movements were observed: (a) slow eye movements (SEMs) --slow, often binocularly asymmetrical, with each cycle usually completed in 3-4 seconds; (b) rapid eye movements (REMs) -- bursts of quick, binocularly synchronous, singular and grouped ocular deviations often in clusters of unidirectional or multidirectional deflections which complete a single cycle in approximately one second. Dement & Kleitman (1957a, 1957b) and Roffwarg, Dement, Muzio, & Fisher (1962) reported that nocturnal dreaming occurred mainly

during periods of cyclically recurring sleep (EEG emerging Stage 1) characterized by random, low-voltage EEG and by rapid eye movements (REMs).

Since these studies were conducted while the subjects slept, reliable self-reporting was difficult to achieve and the type of experimental procedure was restricted. For example, it was generally necessary to wait until the patient wakened by himself after an undisturbed sleep, or was wakened and then asked to recall the dream experience. However, by this time the patient's memory had deteriorated so rapidly that his ability to recount dream content was questionable and perhaps had even affected his awareness of whether he had actually dreamt. Also, Foulkes & Vogel (1965) pointed out that the "dreamlike" process material (e.g., visual, dramatic, and hallucinatory episodes) occurred during descending EEG stages 1 and 2, and thus refuted the insistence that dreaming occurs only during emergent EEG stage 1 sleep.

At the present time, there seems to be two modes of conceptualizing REMs during nocturnal dreaming. Some investigators have interpreted this phenomenon in rather specific psychomotor terms; they have suggested that eye movements represent the dreamer's scanning of his visual images (Dement & Kleitman, 1957b). Others have suggested an alternative which conceptualizes REMs as a non-specific neural mechanism which is a concomitant of attentive activity (Amadeo & Shagass, 1963).

Problem and Hypothesis

The present study attempted to examine: (1) whether REMs are associated with "dreamlike" processes, more specifically during free imagery and dream recall condition, or (2) whether REMs reflect neural mechanisms which are uniquely characteristic of nocturnal dreaming. On the basis of previous investigations which affirmed the occurrence of ocular motility during the waking state (e.g., Amadeo & Shagass, 1963; Singer & Antrobus, 1965), this study predicted the first alternative.

METHOD

Subjects

Ten volunteer male college students enrolled in an introductory psychology course were Ss in the present study. Only male Ss, whose ages ranged from 18 to 29, were used in order to avoid possible confounding sex differences. Except for the selectivity for male Ss, this was a heterogenous group unselected for age or personality characteristics.

Eye Movements

Generally, voluntarily executed movements with eyes closed are distinctly recognizable. However, involuntary eye movements such as those occurring during free imagery are obscured by numerous artifacts including those produced by muscle movements, brain waves, ocular tremors, and blinks. Eye tremors and blinks, for the most part, occur vertically and can be detected on the vertical electrooculograms (EOG). To reduce the effects of the aforementioned artifacts, only eye movements monitored on the horizontal EOG were used to detect the occurrence of REMs.

Eye movements were measured by electrooculograms essentially according to the technique used by Dement & Kleitman (1955, 1957a, 1957b). Conjugate horizontal eye movements were monitored by attaching a pair of Beckman Biopotential electrodes at a point approximately 1 cm lateral to the external canthus of each eye. Vertical eye movements and blinks were identifiable by means of supra and infra orbital Biopotential electrodes on the left and right eye, respectively. Bipolar potentials were recorded for both horizontal and vertical electrode pairs using an electrode attached to the mastoid area of the left ear as a ground.

According to Aserinsky & Kleitman (1955), the EOG contains two patterns of ocular activity (SEMs and REMs), distinguished mainly in terms of duration and latency. In the present study, counts of eye movement frequency were restricted to the more rapid pattern. In order to avoid difficulties in counting very small baseline oscillations and borderline slow eye movements, deflections (REMs) were counted only if they met the following criteria: (1) horizontal EOG deflection was equal to or greater in amplitude than the corresponding deflection on the vertical EOG; (2) amplitude of the horizontal EOG was equal to or greater than 4 mm (10 uv); and (3) duration from base to peak of 0.5 sec or less. Waking REMs of 75 uv (30 mm) or greater in amplitude and occurring in clusters were considered to be comparable to REMs occurring during nocturnal sleep.

Electroencephalograms (EEG)

EEG was recorded bipolarly from the occipital area. Two silver cup electrodes filled with Bentonite electrode paste were attached to the skin by applying U.S.P. collodion. The positioning of the occipital EEG was done according to the International 10-20 Electrode System (Jasper, 1958). The S's right and left ear served as a common reference electrode.

Due to the limitations involved in scoring attenuated alpha rhythm activity by visual inspection, occipital alpha activity was defined as the presence of not less than 3 consecutive waves of 8-13/sec frequency and 2 mm (5uv) or greater in amplitude. Per cent time occipital alpha (% alpha) was defined as the duration of the total observed occipital alpha activity in seconds multiplied by 100 and divided by the length in seconds of the total duration of the episodes or period examined.

In addition to the EEG and EOG recordings, finger pulse and electromyogram (EMG) were monitored to obtain an index of heart rate and muscle activity of the chin, respectively. The finger pulse device, provided by Ax and described in Ax (et al.)(1962), was made from a tiny piezo-electric crystal applied with elastic tape to the forefinger of the S's non-preferred hand. Muscle activity potentials were recorded according to the procedure suggested by Caldwell & Domino (1967a). Silver disc electrodes filled with Bentonite paste were secured by elastoplast tape to the mentalis muscles at the floor of the chin and digastric muscles immediately lateral to the S's left side of the mentalis placement. Both of these indices were recorded for interest's sake and were not directly used for the hypothesis being tested.

The EEG, EOG, EMG, and finger pulse were monitored on a Grass Model 5 polygraph machine. Electrode resistances were checked prior to running the Ss and any electrode giving a reading above 10K ohms was reapplied. The standard EEG constant speed of 10 mm/sec was used and the gain set so that a 20 mm deflection was equivalent to 50 uv.

Procedure

The Ss were given a pre-experimental session individually in order to allow them to experience free imagery and to become accustomed to the laboratory stress situation.

The Ss were instructed to abstain from all sedatives, stimulants, or alcoholic beverages at least 24 hours prior to their experimental appointments one week later. The S sat on a reclining chair in a dimly illuminated soundproof room adjoining the main laboratory in which the experimenter and recording equipment were situated. The Ss were told that the purpose of the investigation was to determine the relationship between visual imagery and certain measurements of cortical and autonomic activity. No mention was made of eye movements. The experimenter then attached the electrodes and instructed the Ss of the need for keeping still, being relaxed, and having his eyes closed for the duration of the procedure.

After a five minute allowance for adaptation to the laboratory situation, a trial run of one minute eyes closed resting period (Relax 1) was recorded to establish a baseline measure for later comparison with free imagery. During this relaxed period, the S was asked to relax, refrain from thinking thoughts or visualizing images, i.e., to "keep his mind blank." Subsequently, each S was thoroughly briefed on the procedure of free imagery as outlined by Reyher (1963):

> The E instructed S through an intercom tape recorder system to "lean back in the chair, close his eyes and report everything that crossed his mind, including images, feelings, and physical sensation, with the focus on visual images." If S reported that he was upset, bothered, or used some other vague term, E asked, "Can you tell me more about that?" to help S express and label poorly differentiated thoughts and affects. During prolonged periods of silence, E asked, "Are there any more images?".

The S was instructed, once the experiment began, to inform the experimenter when he visualized each image and when it disappeared, by pressing a switch with his preferred hand. The switch, powered by a 3 volt (D.C.) battery, activated a signal light in the recording room and thus allowed the experimenter to note the onset and termination of each visual imagery episode on the graph. In order to avoid the possibility of forcing the Ss to conceptualize and concentrate on how to report an image concurrent to his experiencing it and thus possibly contaminating the results, the Ss were asked to describe in detail what they saw after each imagery episode. The latter was recorded on a Uher 400 remote-controlled tape recorder with a built-in two-way intercom system. The free imagery sessions were monitored for a period of 45 minutes.

In addition, in order to determine whether the mechanism of "dreamlike" processes such as free imagery are comparable to the processes involved in nocturnal dreaming, a dream recall condition was monitored in this study. Upon completion of the free imagery phase of the experiment, the Ss were allowed to relax again for 5 minutes. A second trial run of one minute eyes closed resting period (Relax 2) was monitored to establish a baseline measure for later comparison with episode of visual imagery occurring during dream recall condition. After the trial run, the Ss were instructed to close their eyes and visualize scenes from a single previous "vivid" nocturnal dream. As in the free imagery phase of the experiment, the Ss were asked to signal the onset and termination of each visual imagery episode which occurred during the recalled dream. Again, they were asked to describe what they saw after the entire dream was completed. The polygraph record of this phase lasted until the completion of the S's "dream."

RESULTS

Episode

The total number of visual imagery episodes during the 45 minute free imagery phase of the experiment ranged from 28 to 116, with an overall mean of 48.1 and SD of 27.6. In comparison, the total number of visual episodes during the simulated dream phase were less scattered with range between 1 and 6, mean of 3.6 and 1.7 standard deviation.

As expected, the mean duration in seconds of the visual episodes for the dream phase ($\overline{X} = 30.4$ sec) tended to be longer than those occurring during free imagery (11.1 sec, $t = 6.98$, $p \leq .001$).*

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* All reported t tests in this study were computed according to Walker and Lev (1953; pp. 151-154).

Occurrence of REMs

Of the 10 Ss, 9 exhibited REMs during at least one phase of this study. The amount of REMs which exceeded 75 uv in amplitude and occurred in clusters were essentially negligible. Table 1 shows the mean REMs/min under each experimental condition. Data for both the free imagery and dream recall were treated separately by comparing each with a baseline measure or control, in this case Relax 1 and Relax 2 periods, respectively.

Analysis of rapid eye movement measures for both experimental conditions yielded significant t tests (both $p \leq .05$) and show that there is an increase in REMs during the free imagery and dream recall conditions. Recalling a dream did not raise REMs above that found during free imagery ($t = .33$, $p > .50$).

EEG

The comparison of mean per cent alpha between the visual imagery episodes occurring during free imagery and the resting period (Relax 1) are presented in Table 1. The results indicate that there was no decrease in alpha activity during free imagery ($p > .50$). However, there was heightened alpha desynchronization during the visual imagery episodes occurring during the recalled dream when compared to the second resting period or Relax 2 ($p \leq .005$). This result is due to a gross difference between the two Relax conditions; the per cent alpha was the same for the experimental conditions.

Finger Pulse

To obtain an approximate indication of any change in heart rate while the S was visualizing images during either of the experimental conditions, three mutually exclusive scoring categories were devised: low to high, high to low, and constant. Only two categories -- low to high, and high to low -- were used since they reflected visible changes which occurred in the amplitude of the monitored finger pulse record. The starting point was the onset of each visual imagery episode. There is an inverse relationship between amplitude and heart rate.

Table 2 shows the mean per cent corresponding to each of the aforementioned categories. There was a greater per cent increase of heart rate for the dream recall condition but not for free imagery. Although the remaining results were uniformly insignificant, the differences between both experimental conditions in terms of increase of heart rate was great enough to be suggestive.

EMG

The amount of muscle activity of the chin during both the experimental conditions were essentially negative. The EMG when monitored from the chin did not appear sensitive enough to be considered a reliable index for this study.

TABLE 1

Means of REMs and Occipital Alpha for Experimental and Relax Conditions

Episode	$\bar{X}$	S.D.	t
Rapid Eye Movements (Mean REM/min)			
1. Relax 1	1.0	.9	
Free Imagery	2.9	3.1	2.08*
2. Relax 2	1.6	3.1	
Re-called Dream	3.3	5.4	1.99*
3. Free Imagery	2.9	3.1	
Re-called Dream	3.3	5.4	.33
Occipital Alpha (Mean % Alpha)			
1. Relax 1	33.0	23.2	
Free Imagery	33.7	23.5	.11
2. Relax 2	45.0	25.5	
Re-called Dream	32.9	24.6	4.10**
3. Free Imagery	33.7	23.5	
Re-called Dream	32.9	24.6	.28

Note: $N=10$

*$p \leq .05$ (one-tailed)

**$p \leq .005$ (two-tailed)

TABLE 2

Mean Per Cents of Finger Pulse
for Experimental Conditions

Episode	$\bar{X}$	S.D.	t
Finger Pulse Amplitude Trend (Mean %)			
1. Within Experimental Conditions			
a) Free Imagery[a]			
i) Low to high[b]	19.2	12.0	
ii) High to low[c]	24.7	11.2	1.0
b) Re-called Dream[a]			
i) Low to high	11.6	17.6	
ii) High to low	39.3	29.0	2.6*
2. Between Experimental Conditions			
a) Low to high[b]			
i) Free Imagery[a]	19.2	12.0	
ii) Re-called Dream[a]	11.6	17.6	1.3
b) High to low[c]			
i) Free Imagery	24.7	11.2	
ii) Re-called Dream	39.3	29.0	1.6

Note: $N=10$

*$p \leq .05$

[a] Intrinsic anxiety-producing properties

[b] Transition from low to high amplitude (decrease of heart rate)

[c] " " high to low " (increase of heart rate)

DISCUSSION

REMs characteristic of nocturnal sleep were not obtained in either experimental condition. According to Shimazono, Ando, Sakamoto, Tanaka, Eguchi, & Nakamura (1965), REMs occurring during nocturnal dreams are generally lower in amplitude than waking REMs and take less time for deflection. Aserinsky & Kleitman (1955) noted that REMs during nocturnal dreams show relatively jerky motions with short arcs (generally .2 sec), and tend to occur in clusters. On the basis of the aforementioned general characteristics and the 75 uv criteria of nocturnal REMs, the type of REMs which occurred in this study were definitely different in terms of lower amplitude, more gradual slope, and tendency not to occur in clusters.

Also, the dream recall condition in this study seemed more like hypnagogic dreams rather than nocturnal dreams, according to the descriptions of Foulkes & Vogel (1965) and Roffwarg, et al. (1962). First, the entire recalled dream lasted only for a relatively short period of time (mean of 1.4 min) much as though the dream was temporally condensed. As a means of comparison, Dement & Kleitman (1957a) and Caldwell & Domino (1967b) reported mean durations of 9.0 and 11.2 minutes, respectively, in the first occurrence of Stage I-REM. Second, there was almost a total absence (9 out of 10 Ss) of visual continuity of images during the recalled dream. Third, the EEG patterns which occurred during the dream recall condition involved alpha or alpha desynchronization rhythm, whereas emerging stage I EEG during nocturnal dreaming is characterized by low-voltage, non-spindling EEG tracing with occasional theta (4-6/cps) waves. Hence, the results of the present study does not negate the possibility that stage I REMs is a phenomenon uniquely characteristic of nocturnal dreams.

Although stage I type REMs did not occur in this investigation, rapid ocular movements meeting the criteria of Amadeo & Shagass (1963) and Brady & Rosner (1966) did occur. Recently, Lorens & Darrow (1962) postulated that the increase of ocular movement activity during mental multiplication relates to the visual images formed by Ss during calculation. On the contrary, Amadeo & Shagass (1963) stated that the increase of waking REM rate is a non-specific concomitant of attentive activity, whereas Singer & Antrobus (1965) found that REMs characteristic of the waking eyes-closed state are associated with suppression of imagery rather than with the entertainment of an ongoing fantasy.

Moruzzi & Magoun (1949) have shown that alpha blocking is associated with alertness and activity and have also outlined how both external stimulation and cerebral cortical activity affect the blocking of alpha rhythm. More recently, Short & Grey Walter (1954) hypothesized that the suppression of the alpha rhythm in the waking state provides an objective index of the use of visual imagery in solving problems. Barratt (1956) and Costello & McGregor (1957) qualified Short's hypothesis by reporting that the amount of suppression of the alpha rhythm during visual imagery for either problem solving or structured imagery is a result of at least two factors: (1) the vividness of the visual image, and (2) the extent to which thought, associations, or what may collectively be called the higher thought process, are involved.

Since visual imagery occurred during both free imagery and dream recall condition in this study, it was expected that alpha would be suppressed for both condition. Contrary to expectations, alpha desynchronization (relative to a baseline condition) occurred only during the dream reall condition, thus indicating that alpha suppression was not a specific concomitant of visual imagery. Foulkes, <u>et al.</u> (1966) have suggested that "dreamlike" reports which are accompanied by REMs and discontinuous alpha EEG during sleep onset is the ego's defensive response to pressures, e.g., increased instinctual tensions, which arise outside of the ego, rather than a process initiated or directly controlled by the ego itself. In addition, Burns (1967) and Reyher & Smeltzer (1968) reported that the primary process regulated imagery is a powerful and influencing variable. In their studies, whenever Ss experienced visual fantasies during visual imagery that were dominated by primary process, there were increases in conductance as well as GSR activity.

Inspection alone revealed that the bulk of the imagery during free imagery was not primary process regulated. They were visual memories of real events or images of real things. In contrast, the imagery of the recalled dreams was often bizarre, reflecting primary process regulation or the "dreamwork." It is tempting to conclude that alpha desynchronization which occurred during recalled dreaming in the waking state was not a specific concomitant of visual imagery *per se* but instead is a possible indication of the anxiety producing processes being symbolized by the recalled dream and/or the cognitive task of recalling a previous nocturnal dream. This interpretation is supported by the significant increase in heart rate during the visual episodes of the recalled dream and the slight increase in REMs. Future research should attempt to separate these effects.

With respect to REMs, it should be pointed out that the Ss were forewarned a week prior to their experimental session that they would be asked to recall a nocturnal dream. That is, the recalled dream during the experimental session was not a spontaneous (on-the-spot) request. Thus, threatening aspects of the S's original nocturnal dream may have been fairly well controlled by secondary revision and ensued by a consequent reduction of anxiety.

This investigation suggests that further research should focus on the role of primary process as one avenue in pursuing a meaningful articulation between psychodynamic processes and psychophysiology.

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APPENDICES

APPENDIX A

Total and Mean Values of the Subject's Visual Imagery Episodes as a Function of Duration

Subject	Free Imagery			Re-called Dream		
	Total Duration (sec)	Total No. of Episodes	Mean Duration (sec/episode)	Total Duration (sec)	Total No. of Episodes	Mean Duration (sec/episode)
1	449.4	29	15.5	74.1	1	74.1
2	660.9	75	8.8	108.9	6	18.2
3	215.8	28	7.7	52.8	4	13.2
4	567.1	30	18.9	79.5	4	19.9
5	354.9	45	7.9	97.2	5	19.4
6	706.4	32	22.1	89.7	2	44.9
7	193.9	39	5.0	68.9	3	23.0
8	541.6	47	11.5	64.4	2	32.2
9	290.2	40	7.3	126.1	3	42.0
10	734.6	116	6.3	100.2	6	16.7
TOTAL MEAN		48.1	11.1	86.2	3.6	30.4

Total Number and Mean Duration of Visual Imagery Episodes

Notes: 1) S's listed in the order which they were tested.
2) RELAX Period used as baseline measure (Control). Each Relax Period Duration is 60 sec (or 60 cm).

APPENDIX B

Total and Mean Values of the Subject's Visual Imagery Episodes as a Function of Per-cent Occipital Alpha

Subject	Relax 1 Total Alpha (sec)	Relax 1 Mean % Alpha	Free Imagery Total Alpha (sec)	Free Imagery Mean % Alpha	Relax 2 Total Alpha (sec)	Relax 2 Mean % Alpha	Re-called Dream Total Alpha (sec)	Re-called Dream Mean % Alpha
1	11.0	18.3	139.2	31.0	27.8	46.3	32.0	43.2
2	50.6	84.3	497.6	75.3	46.8	78.0	85.5	78.5
3	10.0	16.7	57.7	26.7	14.0	23.3	10.3	19.5
4	31.4	52.3	92.0	16.2	10.6	17.7	5.2	6.5
5	8.8	14.7	75.1	21.1	6.8	11.3	14.5	14.9
6	14.9	24.8	449.2	63.6	50.2	83.7	55.1	61.4
7	16.5	27.5	23.8	12.3	33.4	55.7	17.7	25.7
8	32.2	53.7	290.9	53.7	39.2	65.3	32.3	50.2
9	7.1	11.8	8.2	2.8	15.2	25.3	5.6	4.4
10	15.4	25.7	248.2	33.8	26.3	43.8	24.8	24.8
TOTAL MEAN		33.0		33.7		45.0		32.9

Notes: 1) S's listed in the order which they were tested.
2) RELAX Periods used as baseline measure (Control).
Each Relax Period Duration is 60 sec (or 60 cm).

APPENDIX C

Total and Mean Values of the Subject's Visual Imagery Episodes as a Function of Rapid Eye Movements (REMs)

	Rapid Eye Movements							
Subject	Relax 1	Free Imagery			Relax 2	Re-called Dream		
	REMs per min	Total No. of REMs	Total Duration (min)	Mean REMs per min	REMs per min	Total No. of REMs	Total Duration (min)	Mean REMs/ min
1	2	49	7.49	6.4	8	20	1.20	16.7
2	1	53	11.02	4.8	1	9	1.82	4.9
3	2	2	3.60	.6	0	0	.88	0.0
4	2	1	9.45	.1	0	0	1.33	0.0
5	0	18	5.92	3.0	0	1	1.62	.6
6	0	3	11.77	.3	0	2	1.50	1.4
7	2	29	3.23	9.0	7	9	1.15	7.8
8	0	35	9.03	3.9	0	0	1.07	0.0
9	0	0	4.84	0.0	0	1	2.10	.5
10	1	12	12.24	1.0	0	2	1.67	1.2
TOTAL MEAN:	1.0	20.2	7.9	2.9	1.6	4.4	14.3	3.3

Note: 1) S's listed in the order in which they were tested.
2) RELAX Period used as baseline measure (Control). Each Relax Period Duration is 60 sec (or 60 cm).

APPENDIX D

Total and Mean Values of the Subject's Visual Imagery Episodes as a Function of Finger Pulse Amplitude Trend

Subject	Finger Pulse Amplitude Trend											
	Free Imagery						Re-called Dream					
	L→H		H→L		Constant		L→H		H→L		Constant	
	Total No.	%	Total No.	%	Total No.	%	Total No.	%	Total No.	%	Total No.	%
1	0	0.0	5	17.2	24	82.8	0	0.0	0	0.0	1	100.0
2	30	40.0	7	9.3	38	50.7	1	16.7	2	33.3	3	50.0
3	6	21.4	8	28.6	14	50.0	2	50.0	2	50.0	0	0.0
4	3	10.0	11	36.7	16	53.3	0	0.0	0	0.0	4	100.0
5	5	11.1	7	15.6	33	73.3	0	0.0	3	60.0	2	40.0
6	11	34.4	13	40.6	8	25.0	0	0.0	2	100.0	0	0.0
7	4	10.3	13	33.3	22	56.4	0	0.0	1	33.0	2	67.0
8	10	21.3	11	23.4	26	55.3	0	0.0	1	50.0	1	50.0
9	8	20.0	13	32.5	19	47.5	1	33.3	1	33.3	1	33.4
10	27	23.3	12	10.3	77	66.4	1	16.7	2	33.3	3	50.0
TOTAL MEAN		19.2		24.7		56.1		11.6		39.3		49.1

Note: 1) S's listed in the order in which they were tested.
2) L→H : Low to higher amplitude (decrease of heart rate)
H→L : High to lower amplitude (Increase " " ")
Constant : No gross changes in amplitude (or " ").

APPENDIX E

Intercorrelations Among the Various Conditions for Rapid Eye Movements (REMs) and Per-cent Occipital Alpha [a]

Variable	1	2	3	4
A. Rapid Eye Movement				
1. Relax 1		.339	.564	.484
2. Free Imagery			.830**	.723*
3. Relax 2				.928**
4. Re-called Dream				
B. Per-cent Occipital Alpha				
1. Relax 1		.636*	.486	.595
2. Free Imagery			.810**	.941**
3. Relax 2				.902**
4. Re-called Dream				

[a] Pearson Product-moment Correlations

* Significant beyond .05 level.

** " " .01 "