REM SLEEP AND THE EFFICACY OF THE DUAL IMAGE MODEL

An Investigation of the Dual Image Model structure of dreaming using vivid and vague images from Tonic and Phasic REM dream reports

SHIRIN FERNANDEZ B.A.(Hons.)

A report of an investigation submitted as a partial requirement for the degree of Master of Psychology, in the Department of Psychology.

University of Tasmania
February 1990

CONTENTS

CONTENTS (Cont.)

ACKNOWLEDGEMENTS

'Twas Bacchus (Iain Montgomery) who introduced it,
To Morpheus (John Davidson) who perused it,
And together they found a muse to prove it.

And so she began with a fee to woo,
But not having a clue about what dreams do.
Like a pirate of the night, she gave them a fright,
And raided their dreams for themes from the preceding schemes.

Wake O Child! from slumbers' arms,
And tell me which is vivid and which is vague,
For mighty judges Pegasus (Helen Hornsby), Ganesa (Steve Smallbone),
Friga (Jo Jordan) and Haroeris (Brett Daniels), will rate what you state,
And bring to light what is right.

And so the story went on...

To my supervisors John Davidson and Iain Montgomery for their ideas, encouragement and tolerance.
To the subjects who kindly volunteered their dreams.
To the raters Helen Hornsby, Brett Daniels, Jo Jordan and Steve Smallbone.

To Jo Jordan for accompanying me through what seemed to be endless nights of data collection and her kindred spirit.
To Helen Hornsby for her encouragement, help and support at every stage.
To Michelle McInnes and Pauline O'Connor for their help and criticisms.
And together to Jo, Helen, Michelle and Pauline for their friendship.

Finally, to my family Betty and Richard Benson and Zeena and Lawrence Arturo who continually provided support from afar.

Thank you for helping create a dream...

Abstract

Seligman and Yellen (1987) have formulated a dual imagery theory of dream production. They hypothesise that in dreams vivid imagery is independently physiologically generated and will be unconstrained by the plot of the dream, while vague imagery will be constrained as it is produced by a process of cognitive synthesis which integrates the visual bursts into a more or less coherent story. A study using 15 subjects who slept in a sleep laboratory for one night was used to test this model. Subjects were awakened during tonic and phasic REM periods of the night and asked to recall their dreams and to rate the clarity of "the last most vivid image" and "the most vague image".

This study examined three main groups of hypotheses related to Seligman and Yellen's (1987) theory of dream construction: (1) The differences in vividness or clarity of imagery between tonic and phasic REM, (2) The differences in surprisingness of vivid and vague images in relation to the preceding plot, and (3) Incorporation of events from the precious day in dreams and comparison of incorporation in vague and vivid imagery.

The results supported the first hypothesis on the differences in clarity of imagery between tonic and phasic REM sleep. This finding is consistent with previous studies of tonic/phasic differences (Molinari & Foulkes, 1969). In testing the second hypothesis it was found that there was almost no difference in ratings of the surprisingness of vivid and vague images in relation to the preceding plot. Furthermore, vivid images were also judged to be context related when interchanged between two phasic dreams collected on the same night. The third hypothesis concerned incorporation of events from the previous day in dreams. It was found that there was more direct incorporation from the subject's own diary record than from a

diary of a randomly matched subject. There was, however, no differential process in incorporation between vivid and vague images.

Thus, contrary to the Seligman and Yellen (1987) theory there is evidence that vivid images are at least partially constrained by a process of cognitive construction in the formation of a dream, and there is no evidence of any differences in the cognitive constraint on vague and vivid images.
The results of this study are not consistent with he Seligman and Yellen (1987) theory and instead implicate a process of cognitive construction in the formation of vivid as well as vague images.

CHAPTER ONE

INTRODUCTION

The sadness we bring back from sleep
like a herb in the mouth . . . sage? rosemary?
like a fragrance we can neither lose nor keep . . . woodsmoke? oak-leaves?
like the closing softly of a distant . . . distant? door . . .
Oh like earth on our shoes from an unremembered journey . . .
What earth? What journey ? Why did we return ?
- Archibald MacLeish (Waking)

The $64,000 question regarding sleep is "what is it all for ?". Sleep is a behaviour exhibited by mammals among other animals. Mammalian sleep with its highly differentiated components of non rapid eye movement (NREM) and rapid eye movement (REM) phases is unlikely to be dedicated to any one particular function (Aserinsky & Kleitman, 1953).

Many of the theories about the functions of sleep concentrate on dreams or dreaming which occurs during "rapid eye movement" sleep (REM sleep). In some early civilizations dreams were thought to originate, not from within the mind of the dreamer, but from an outside agency, often a supernatural power, which put them into our minds to warn us of things to come. The ancient Egyptians, Greeks and Romans held this view and even built special temples where oracles gifted in understanding dream meanings could be consulted (Van de Castle, 1973). Some information processing theories on the other hand believe that we dream in order to forget (Crick & Mitchison, 1983) or that dreams serve as a memory filter to screen the experiences of the day and reject the redundant or inappropriate information (Evans & Newman, 1964). Clearly however dreams may be regarded as the most enjoyable and noticeable part of sleep.

There are numerous questions which are associated with the functions of REM sleep and one of its concomitants, dreams. The structural characteristics of dreaming - hallucinatory, bizarre, story-like sequences of predominantly visual imagery - have seemed to demand extraordinary forms of explanation (Aserinsky & Kleitman, 1953; Hobson & McCarley, 1977, Davidson & Schwartz, 1976; Seligman & Yellen, 1987). The processes by which the stream of thought and imagery is generated in waking or sleep are poorly understood. We do not know how thoughts and images are coordinated across sensory modalities or sequenced in time.

Exploration of the relationship between the psychophysiology of REM sleep and dreams is discussed in Chapter 2, with a particular emphasis on the Tonic-Phasic Model and REM sleep mentation (Aserinsky & Kleitman, 1953; Moruzzi, 1963, 1965).

Theoretical models of the structure of dreams are reviewed in Chapter 3 with a particular emphasis on the Activation-Syntheisi Hypothesis by Hobson and McCarley (1977), the Hemisphere Activation Model by Davidson and Schwartz (1976) as well as the Dual Image Model by Seligman and Yellen (1987).

Chapters 4 to 6 report an experimental investigation of the Dual Image Model of the structure of dreams while making use of the Tonic -Phasic Model and the sleep mentation associated with these phases.

CHAPTER TWO

PSYCHOPHYSIOLOGY OF REM SLEEP AND DREAMS

Sleep affords the opportunity,
within certain limits, for the brain to
act of itself, and dreams are the result.

-Edward Clarke
Vision: A Study of False Sight (1878)

2.0 INTRODUCTION

Research on the dream process and its physiological concomitants gained momentum when Aserinsky and Kleitman (1953, 1955) and Dement and Kleitman (1957) investigated the relationship between electroencephalograph (EEG) and electrooculogram (EOG) records and dreaming. Since there has been considerable interest in the psychological aspects of dreaming for centuries it is understandable that great excitement was generated when these experimentalists reported that dreaming was associated with periods of rapid eye movement (REM) sleep. The original studies from Kleitman showed that 74 percent to 88 percent of awakenings during REM sleep produced dream reports, while less than 10 percent of the awakenings during slow wave sleep (SWS), sometimes referred to as non-rapid eye movement (NREM) sleep did so.

Their findings indicated that the dream episodes are accompanied by a continuous, low voltage, high frequency activity, desynchronized EEG

pattern, diminution of muscle tonus, rapid and irregular cardiac and respiratory rates (Gould,1983). The REM episodes are most easily recognized in laboratory situations by the concomitant sporadic, rapid, darting movements of the eyes referred to as REM.

The main biological characteristics of NREM sleep are progressive slowing and increase in amplitude of brain waves, decreasing muscle tone, slowing of heart rate and respiration, and relative bodily quiescence. REM sleep is qualitatively quite distinct. Some of the physiological characteristics include, increases in heart rate and especially, increased variability of autonomic functions; the presence of penile erections in males and increased vaginal blood flow in females; positive transient motor phenomena including twitching movements of the extremities and facial regions and of course, the bursts of rapid eye movements themselves (Broughton, 1975, p. 218).

There are a number of theories that relate to the function of the REM stage in sleep. One such theory sees increased protein synthesis as both a consequence of sleep and as a causal factor of sleep. Synthetic levels may be viewed as a reflection of cellular repair underlying a restorative process (Adam, 1980) during sleep. Drucker-Colin (1981) found that protein concentration peaks were shown to correspond with sleep periods in which REM was predominant. Drucker-Colin, de Gomez-Puyon, del Carmen Gutierrez and Dreyfus-Cortes (1980) also showed in that there is a specific decrease in REM which can result from treatment by protein synthesis inhibitors. Another theory by Dement (1969) hypothesized that REM sleep

served as a "safety valve" which allows concentrated neural activity to occur in the brain without any behavioural consequences. Berger also in (1969) saw sleep and REM periods in particular as serving the mechanisms necessary for conjugate eye movements - that is, eye movements where the two eyes move together to construct a single three-dimensional visual image. Ephron and Carrington (1966) in suggesting their homeostatic hypotheses saw the REM state as a mechanism which served to counteract the tendency toward lowering of cerebral "tonus" or "vigilance" during sleep. The REM state periodically provided "endogenous afferentation", which is a kind of patterned sensory input similar to that presented during waking perception.

Information processing theories of REM function imply (1) an active and progressive elaboration of existing information and (2) an active role in the consolidation of previously learned experiences (Kosslyn & Pomerantz, 1977). The latest variation on this theme is the theory that the psychological function of REM sleep is to eliminate unwanted information: "We dream in order to forget" (Crick & Mitchison, 1983). These researchers based this 'erasure' theory on the abstract but compelling concept that a system as elaborate as the brain is in danger of dyscontrol via intensification of its oscillations. Although interesting the information processing theories are difficult to test but some simple clinical studies can be imagined such as the tendency to hallucinate should be lower in the morning than before the night of sleep (Hobson, 1988).

While the REM state occurs in all stages of life it predominates in infant sleep. In the first three months of life infants have greater than 50 percent REM sleep and then after this period it is gradually reduced to the normal adult sleep pattern of roughly 20-25 percent REM (Ellingson & Peters, 1980). The Active Sleep state (a term used for infant sleep) may reflect a more rigidly determined, "primitive organizational state which is less influenced by postnatal changes" (McGinty & Sterman, 1980). Such a conclusion would be consistent with existing evidence for the emergence of the Active State cycle during fetal developments (Sterman, 1967; Astic & Jouvet -Mounier, 1969).

Theories which seek to understand the function of REM sleep have concentrated on the REM deprivation research. This research has shown that on successive recovery nights the total amount of REM sleep rises significantly (Dement, 1960; Fisher & Dement 1963; Kleitman 1963). This is called the rebound effect.

Psychological effects of REM deprivation from clincal studies have included : heightened levels of tension, anxiety and irritability; difficulty in concentrating; marked increase in appetite with consequent weight gain; motor incoordination; disturbance in time sense and memory and latent hallucinatory tendencies (Pivik & Foulkes, 1966).

Another possible source of data on the effects of REM deprivation which point to the same conclusions occur after the consumption of alcohol,

barbiturates and sedatives which reduce REM periods as much as 50 percent, but their effectiveness diminishes with continued chronic use. (Gresham,Webb & Williams, 1963). When suddenly withdrawn, there is a rebound effect that could result in vivid nightmares as has been shown in some clinical literature (Freemon, 1972). This literature also shows that severely depressed patients and undue stress in normal subjects also leads to a decrease in REM sleep (Brown & Cartwright, 1976). For example, Cartwright, Lloyd and Trenholm (1982) found that upsetting life events such as death and divorce are associated with less dreamlike reports especially in the first REM period. Also the mood tone was more unpleasant. Their two year follow-up showed those more depressed initially changed to have more dreamlike REM reports, particularly in the first REM period which also became more positive in mood.

The major cognitive characteristic of REM periods is its association with dreaming. Apart from the Kleitman study mentioned earlier, Monroe, Rechtschaffen, Foulkes and Jenson (1965) found that when "blind" judges were asked to discriminate reports given after awakenings made from REM and NREM sleep there was 90 percent accuracy on the basis of those having dream-like characteristics (ie. hallucinatory and contains a succession of visual images, and at times sounds; the participation of other sensory modalities, appearing in a sequence, rather than as a single scene, and which may vary in vividness, bizarreness, amount of participation of the sleeper) compared to those having thought-like characteristics (ie. not hallucinatory, but generally consists more of thoughts usually somewhat drifting and

undirected, or at least poor in logical structure) . Not only do REM periods yield dream reports more frequently than do awakenings made from NREM sleep, but within the REM stage awakenings made 9 or more minutes after the REM period has begun yield more dream-like content than do awakenings made at the beginning of the period (Foulkes, 1966). Within REM periods Molinari and Foulkes (1969) reported that awakenings made during bursts of rapid eye movements were more likely to yield "primary visual experience" reports whereas those made during REM intervals when the eyes were quiescent were more likely to yield thought-like reports.

Aserinsky (1967) noted that the REM period is not homogenous but is made up of both tonic and phasic phenomena (the tonic being the continuous low voltage random EEG activity and the drop-out of the muscle potential, as well as the phasic intermittent rapid eye movements, muscle twitches, and short-term autonomic changes in respiration and heart rate). He suggests that dreaming is more closely associated with the presence of the phasic events than with the state as a whole. This was later supported by Molinari and Foulkes (1969). Since some phasic activity also occurs during NREM sleep, the question was raised by Grosser and Siegal (1971) of whether the ongoing cognitive activity seen in NREM takes on a dream-like quality in REM. This possibility is supported by the studies of the interrelatedness of mental content collected across the night and from those studies of the continuity between adjacent NREM and REM reports (Foulkes, 1962; Offenkrantz & Rechtschaffen, 1963; Verdone, 1965). The thrust of this work suggests strongly that basic lines of thought are identifiable throughout the

sleep of one night, although the style of its expression shifts from more conceptual to more perceptual during different sleep stages and times of night. It is also observed that the proportion of REM to NREM sleep is greater at the end of the night than the early part of the night which may support the notion that dream content increases as the night progresses. Therefore as observed, dreams extend in length "anywhere from a few minutes (typical of the first dream of the night) to forty minutes or more at nights end" (Cartwright, 1977, p.10). This also qualifies an order effect for REM period position upon dream content (Kramer, McQuarrie & Bonnet, 1982).

Another line of approach to identify dreaming has been to ask subjects to make an instrumental response during sleep to indicate the presence of dream activity. There have been studies establishing that subjects can discriminate REM fron NREM sleep by using a hand-held microswitch and the instruction to close it when dreaming. Antrobus, Antrobus and Fisher (1965) and Salamy (1970) were able to show that all subjects could identify REM periods 85 percent of the time. However in both of these studies, responses made in stages other than REM were scored as errors rather than the possibility of these responses being NREM dreams. In 1977 Brown and Cartwright established the validity of this kind of dream detection while using two conditions of experimenter-initiated awakenings and subject-initiated awakenings by means of a micro-switch. Since the dependent variable was imagery content it was found that subject initiated awakenings were slightly higher in REM periods (93%) than they were in

NREM periods (79%) indicating the fact mentioned earlier that REM periods are characterized as having more imagery than NREM periods. However these experimenters did not report whether this difference was significant. The large percentage of NREM indications by the subjects, could show that it is difficult to differentiate dream like imagery from thought-like imagery.

Waking in REM periods is a strategy for collecting dreams as has been shown by studies comparing samples of home and laboratory dream reports from the same subjects (Domhoff & Kamiya, 1964; Meier, Ruef, Ziegler & Hall, 1968). Early studies indicated that dreams collected in the laboratory were reported to be less aggressive and less dramatic in general than those dreams at home (Domhoff & Kamiya, 1964; Meier, Ruef, Ziegler & Hall, 1968). However, later experiments which were concerned about "the equipment, setting and method of reporting" (p. 590) in the laboratory found no significant effect on basic dream processes as imagination, distortion, dramatization, clarity and emotional intensity (Weisz & Foulkes, 1970). However, dreams collected in the laboratory do often include the laboratory situation itself which is clearly not a usual dream topic (Dement, Kahn & Roffwarg, 1965; Snyder, 1970). Dement et al. (1965) reported evidence that adaptation to the laboratory continued within the first night, from the first to the last awakenings. Dreams which involved direct incorporation of the laboratory dropped from 43 percent of those recalled from the first REM period of the first laboratory night to 16 percent of those reported from the sixth awakening on night one.

It was observed that subjects who had more "personal involvement" in the study had a higher incidence of direct incorporation of the laboratory situation. Similar results have been confirmed by Piccione, Thomas, Roth and Kramer (1976). Therefore in any research which involves a laboratory setting and collection of dream reports it is sometimes advantageous for subjects to begin with an adaptation night so as to minimize interference from their presleep environment.

2.1 THE SCANNING HYPOTHESIS

Associated with the tonic-phasic distinction during the REM phase of sleep is the "scanning hypothesis". Researchers in the early sixties and seventies such as Wolpert (1960), McGuigan and Tanner (1970), Grossman, Gardner, Roffwarg, Fekete, Beers and Weiner (1971) had some success with studies relating discrete motor activity, namely eye movements, to REM sleep mentation. These studies have described the eye-movement-dream-content relationship from two perspectives, one suggesting a very precise correspondence between the two variables and another noting a general, nonspecific association. The "scanning hypothesis" in particular is the notion that the eye movements are elaborated in the services of scanning the dream imagery. Rechtschaffen in his (1973) paper extensively reviews this controversy and concluded that the issue was still in doubt. The hypothesis remains controversial even today but has been used in the lucid dreaming research (LaBerge, 1985). The second, nonspecific view is supported by data relating the presence of eye movements to the vividness

and emotionality of the dream (Hobson, Goldfrank & Snyder, 1965; Verdone, 1965) and to activity within the dream (Berger & Oswald, 1962 b; Pivik & Foulkes, 1968).

The scanning hypothesis has been tested in lucid dreaming research by LaBerge, Nagel, Dement and Zarcone (1981) and LaBerge (1985). They have shown that during REM sleep, certain subjects can signal that they are dreaming lucidly by means of volitional eye movements (recorded by the electro-oculogram) and forearm muscle contractions (recorded by the electromyogram). The subject when woken could then recall images from the dream which occured before and after they signaled that they were dreaming. In a single case study by Fenwick, Schatzman, Worsley, Adams, Stone and Baker (1984) the subject planned to move his finger smoothly from side to side within the dream and follow it with his eyes to determine if he could produce slow scanning movements of his physical eyes. The magnetic tape which was recording the subjects sleep showed that the subject did tracking movements with his eyes. This indicates that volitional high-precision eye movements are possible during REM sleep, and that, when 'dream eyes' follow the movements of the 'dream hand', the eyes move in the same way they would if the dreamer were awake and following slow to-and-fro movements of his hand.

2.2 TONIC - PHASIC DISTINCTIONS

The strongest psychophysiological association which was to distinguished REM from NREM mentation was the association between eye movements

and dream content. Knowledge about this relationship has not changed greatly since Aserinsky and Kleitman published their initial 1953 report. A re-examination of this model came with Moruzzi's (1963, 1965) distinction between tonic and phasic characteristics of stage REM.

Moruzzi pointed out that some of the physiological features of stage REM are "tonic". That is, they extend more or less continuously throughout what is conventionally considered a unitary "period" of stage REM. These include, for example, the low-voltage mixed frequency EEG tracing and the EMG suppression. Other characteristics of stage REM, however, most notably the rapid eye movements themselves, are "phasic". That is, they occur intermittently during stage REM and include ponto-geniculo-occipital (PGO) spikes and the periorbital intergrated potential (PIP's). It is this phasic activity plus tonic background activity which is the more obvious sign of REM sleep.

Moruzzi appeared to be postulating more than a descriptive differentiation between tonic and phasic REM. He suggested that the episodic intrusions of phasic events within REM represented activity which was fundamentally different from the tonic background upon which it was superimposed. Moruzzi wanted a clear distinction between events defined as tonic and phasic to be demonstrated.

Research designed to elucidate tonic and phasic REM activity began employing a variety of experimental approaches including lesioning

techniques (Jouvet & Delorme, 1965), pharmacological intervention (Delorme, Jeannerod & Jouvet, 1965), and behavioural manipulation (Ferguson & Dement, 1968). Lesions of different brain stem nuclei, for example, were shown to result in the selective elimation of either tonic or phasic components of REM sleep. Bilateral destruction of the nucleus locus coeruleus elimated tonic muscular inhibition of REM sleep leaving PGO spiking and eye-movement activity intact (Jouvet & Delorme, 1965). Conversely, after complete ablation of the medial and descending vestibular nuclei, the integrated bursts of PGO spiking, eye movements, transient EMG, and reflex inhibition, and autonomic changes were no longer present in REM sleep (Morrison & Pompeiano, 1970). The only evidence of phasic activity remaining after this lesion was the sporadic occurrence of isolated PGO spikes and eye movement. The results of these vestibular lesion studies were important in demonstrating the separateness of tonic and phasic events, but were also relevant to Moruzzi's second proposal that the widespread phasic activity might originate from a single common generator. The tendency for phasic activity to occur in clustered bursts during REM sleep in both the human and the cat suggested this might be the case, and the comprehensive elimation of such bursts of activity through selective vestibular lesions indicated a fundamental role for these nuclei in the generation of these events.

Further proof of the independence of tonic and phasic events was provided by studies demonstrating that phasic events could be displaced from REM sleep. It was observed that the suppression of REM sleep, by means of either

forced awakenings at the onset of each REM period (Ferguson & Dement, 1968; Ferguson, Henriksen, McGarr, Belenky, Mitchell, Gonda, Cohen, & Dement, 1968) or the administration of biochemicals (Delorme, Jeannerod & Jouvet, 1965) resulted in the enhancement of PGO spiking during slow wave sleep. Dement (1969) and Ferguson et al. (1968) made use of these results to take another look at the REM deprivation-compensation phenomenon. Typically, the suppression of REM sleep is followed by partial compensation of the REM sleep loss. However, by behaviourally or pharmacologically manipulating the number and distribution of PGO spikes, these investigators were able to regulate and even obviate the compensation phenomenon. Using animals, they deprived them of a few seconds of NREM sleep at the onset of spike intensification preceding REM onset. In addition to the normal curtailment of REM effected during REM deprivation, it was possible to enhance the amount of rebound over that produced by the classical REM deprivation procedure. These studies, by showing the intimate relationship between PGO spike activity and REM deprivation phenomena, imparted a functional significance to the PGO spike independent of the tonic processes of REM sleep.

The PGO spike has been the investigatory tool for the study of the psychophysiology of dreaming. Specifically, in addition to being concentrated in REM sleep where reports of dreaming are most prominent, PGO spikes are strongly identified with the visual system, and may occur in association with quite generalized increases in activity (Hobson & McCarley, 1971). They have been observed in the presence of hallucinatory-like

behaviour during wakefulness in cats (Dement, Zarcone, Ferguson, Cohen, Pivik & Barchas, 1969). This observation is in accordance with Pivik's (1974) conception of dreaming which he sees as "hallucinatory mental experiences of a highly visual nature occurring during sleep" (p. 256).

Therefore psychophysiological correlates such as these, together with the physiological data suggest that PGO spikes represent a primary triggering process for phasic events in general and are crucially involved in the REM deprivation-rebound phenomenon. This prompted investigators to view the feline PGO spike as the standard phasic event against which all others were to be evaluated.

The hypothesis that the PGO spike is an intimate correlate of dreaming in the human is based largely on general similarities between the two in distribution and intensity within the sleep cycle, as well as the shared accentuation upon the visual modality. Pivik (1974) has examined and summarised five possible points of correspondence which allows for a comparative analysis, having to do with distributional patterning of PGO spikes and sleep mentation:

1) PGO spikes are highly concentrated in REM sleep, a time when dreaming is most prominent.

2) Measured at the pontine level, spikes increase in amplitude and frequency within a REM period (Brooks, 1968), a pattern which finds a parallel in the increased intensity of dreaming as a function of REM time (Foulkes, 1966).

3) Spiking during NREM sleep is most intense in the 30-60 seconds preceding each REM period.

4) Deprivation of REM sleep in the cat increases the density of spiking within REM sleep during the ensuing rebound, and increases the incidence of NREM-spike activity during the deprivation manipulation (Dement, 1960). Correspondingly REM deprivation in the human tends to intensify REM dream content during the recovery period and enhances NREM mentation during the deprivation procedure. With respect to the former, both negative (Antrobus, Arkin & Toth, 1970; Carroll, Lewis & Oswald, 1969) and positive (Pivik & Foulkes, 1966) results have been reported. Although studies looking for the postulated intensification of NREM mentation during REM deprivation have been few, and the results negative (Arkin, Antrobus, Toth & Baker, 1968), these results are based upon either small numbers of awakenings or did not sample from all NREM sleep stages and are accordingly limited in their generality.

5) PGO spikes are virtually absent at sleep onset, although several reports are consistent in demonstrating a great deal of very dreamlike activity occurring at this time in the human (Foulkes & Vogel, 1965; Vogel, Foulkes & Trosman, 1966).

The five general comparisons listed above constitute a largely inadequate test of the spike-content relationship, or the tonic-phasic model as it applies to sleep mentation. A more direct test of the model as it applies to REM sleep (Aserinsky, 1967) suggested that a comparison among content reports

elicited from intra-REM awakenings made during periods of ocular motility (phasic), ocular quiescence (tonic), and NREM sleep might reveal greater qualitative similarity between the REM tonic and NREM reports than between those from REM tonic and REM phasic arousals. This suggestion is an explicit statement, presented in terms of human psychological research. It totally disregards any possible distinctions within NREM sleep or between REM and NREM sleep deriving from the presence of phasic activity in NREM sleep.

2.3 THE TONIC-PHASIC MODEL AND REM SLEEP MENTATION

Investigations which have sought to differentiate phasic from nonphasic periods in REM sleep have relied upon the presence or absence of eye movements for such differentiation and sometimes in conjunction with additional measures (Foulkes & Pope, 1973; Watson, 1972).

Researchers such as Roffwarg, Dement, Muzio and Fisher (1962) were interested in the moment to moment variability of the dream experience and chose a more microscopic methodology in the collection of dream reports in which attention was focused upon the last experience pre-awakening mental event. This technique was used extensively in tests of the scanning hypothesis. Other researchers who were aware of the experimental demands upon their subjects such as rapid arousal from sleep and attentiveness to the mental experience with special emphasis upon detail, took to carefully selecting their subjects (Foulkes & Pope, 1973; Molinari & Foulkes, 1969). These carefully constructed methodologies were

seen as necessary for testing the viability of the tonic-phasic model, at least for REM sleep.

Some of the earliest studies using these carefully constructed methodologies to test the tonic-phasic model were conducted by Molinari and Foulkes (1969) and Pivik, Halper and Dement (1969), and their data plus others who used these techniques agree that the presence of visual or auditory imagery does not differentiate between "tonic" and "phasic" reports, although "phasic" reports are associated with a greater incidence of both kinds of imagery. They also found that the presence of phasic activity did seem to somewhat enhance recall and content elicited from phasic arousals contained significantly more hostility (Pivik, 1971; Watson, 1972), self-participation (Bosinelli, Cicogna & Molinari, 1973), but less conceptual, thought-like material (Molinari & Foulkes, 1969; Pivik. 1971).

In none of the above mentioned studies is any time factor indicated with regards to duration of tonic-REM period and duration of phasic-REM period, however, Aserinsky in his 1971 and 1973 papers defines the REM bout as being made up of periodic *bursts* lasting about 2-9 seconds alternating with REM quiescences each lasting about 16-20 seconds.

Molinari and Foulkes (1969) found they could differentiate between content elicited from REM phasic and tonic arousals by classifying the reports as primary visual experiences (PVE) or as secondary cognitive elaborations (SCE). Reports were scored for PVE when the very last experience consisted

of passively received, nonintellectualized, "thoughtless" imagery (like, watching a clock), and for SCE when this experience included evidence of active conceptualization, cognition or verbalization (like, watching a clock, but considering the indicated time; or thinking about time in the absence of any imagery). REM phasic reports were found to be associated with PVE, whereas the content from REM tonic awakenings and from three categories of NREM sleep (ascending Stage 2, and sleep onset Stages 1and 2) were characterized by mental activity of the SCE type. This initial study concentrated upon the last experience related in the subject's spontaneous reports. The within-REM findings were subsequently replicated by Foulkes and Pope (1973), but it was also found that if, following the spontaneous report, subjects were specifically asked about the presence of SCE-type material, the response was generally affirnative. In other words, although PVE was a very prominent aspect of REM phasic content, conceptual activity was nevertheless present at this time and could be elicited upon direct questioning.

Rechtschaffen, Molinari, Watson and Wincor (1970) have used PIP's as an index of phasic activity. PIP's regularly appear along with eye movements during REM, but appear occasionally in REM with no eye movements. Rechtschaffen and Buchigiani (1983) woke individuals from REM sleep during vigorous PIP's or during their absence. The subjects then matched the visual imagery that they had last experienced to a set of 129 slides that varied along the dimensions of clarity (of either figure or ground), colour, brightness and saturation. They found significantly better figure clarity

during phasic activty suggesting more hallucinatory visual imagery during phasic activity. There were however no significant differences in colour, brightness or saturation.

It is not only visual, but also perhaps auditory hallucinations that concentrate in phasic REM. Pessah and Roffwarg (1972 b) measured bursts of middle ear muscle activity (MEMA's) in cats and humans. They found a concentration of MEMA's in REM in both species. Among five humans, MEMA's appeared in every REM period, sometimes with and sometimes without bursts of eye movements. Since MEMA's accompany listening to loud noise in the waking state Roffwarg, Adrien, Lamstein, Pessah, Spiro and Bowe-Anders (1973), woke subjects after MEMA's during REM and asked about auditory material. Seventeen out of 21 predictions from awakenings were correct.

In summary it may be said that the early notion of a relatively uncomplicated state in which mind-body relationships might be profitably studied caused investigators to have an oversimplified view of sleep psychophysiology. Although this was perhaps useful in terms of stimulating interest and promoting popularity, it was inadequate to the task of answering questions raised by the data. It was thought that once sleep was fractionated into tonic and phasic components and use was made of the carefully collected dream reports in conjunction with the physiological measures, then the task at hand would be easier.

This is however not the total case. The evidence as presented suggests that when individuals are woken from phasic REM activity they may report more primary visual and auditory events than from tonic REM sleep. It may however be as Foulkes (1973) says, "that what differences may emerge between phasic and non-phasic moments will have to be relatively subtle, and may reveal a slightly different 'mix' of dream functions, rather than any kind of qualitative alternation".

CHAPTER THREE

THEORIES ON THE STRUCTURE OF DREAMING

Friend,
many and many a dream is mere confusion,
a cobweb of no consequence at all.
Two gates for the ghostly dreams there are: one gateway
of honest horn, and one of ivory.
Issuing by the ivory gates are dreams
of glimmering illusion, fantasies,
but those that come through solid polished horn
may be borne out, if mortals only know them.

- Homer, *The Odyssey*, Book XIX

3.0 INTRODUCTION

The structural characteristics of dreaming - hallucinatory, bizarre, story-like sequences of predominantly visual imagery - have seemed to demand extraordinary forms of explanation. The processes by which the stream of thought and imagery is generated in waking or sleep are poorly understood. We do not know how or why people generate stimulus-independent images and thoughts when asleep, or for that matter, when awake with their eyes closed, or open and, say, for example when driving a car. We do not know how thoughts and images are coordinated across sensory modalities and sequenced in time. That the characteristics of the verbal reports of such

imagery vary across biological states (Aserinsky & Kleitman, 1953) and environmental contexts (Antrobus, Singer & Greenberg, 1966) affords an opportunity to isolate the salient properties of such cognitive processes and to determine how biological states and environmental contexts influence these characteristics.

Cognitive researchers approach dreaming from the basis that any comprehensive model of thought and imagery must be able to account for how sleep mentation is produced. This reasoning has produced memory based theories (Foulkes, 1982) which state that dreaming requires processes of mental analysis and synthesis and occurs when minimal external stimulation allows for activation of primary memory units that is, mnemonic activation. This processing is not random but purposeful activity, since self relevant material is processed in order to organize it into appropriate memory categories. Cartwright (1986) asserts that the self relevant material is in particular, emotional material.

The search for specific neurological generators of dreaming has attempted to locate cortical and subcortical structures. This line of enquiry has produced the hemisphere activation models of dreaming (Broughton, 1975; Antrobus & Ehrlichman, 1981) and the activation synthesis model (Hobson & McCarley, 1977) on which Seligman and Yellen (1987) base their dual image theory.

3.1 ACTIVATION-SYNTHESIS MODEL OF DREAMING - HOBSON AND McCARLEY

Research in dream physiology has been fruitful in generating theories of the structure of dreaming. In their activation-synthesis model Hobson and McCarley (1977) try to conceptualize how the brain-mind is activated during sleep in such a way as to account for the distinctive cognitive features of dreaming.

They propose that dream stimuli appear to arise by the mechanisms of brain activation which are internally generated information signals (PGO waves). These originate in the brain stem namely the pons, and specifically, the 'FTG' neurons (the initials 'FTG' come from the French language version of the giant cells of the pontine tegmentum). The PGO waves are strong pulses of excitation which are said to cause the rapid eye movements. These strong pulses of excitation are conducted from the brain stem to the thalamus. They are also sent via independent pathways to both the visual and the association cortex. Thus, according to these researchers not only is internal information generated in REM sleep, but that information has a high degree of spatial specificity. Therefore, according to the activation-synthesis hypothesis of dreaming the now auto-activated (ie. processing the information), disconnected (ie. disconnected from motor output so as to prevent gross motor movements of the entire body) and auto-stimulated (ie. not to overtly act upon the internally generated information), brain processes these signals which are interpreted in terms of information stored in memory.

According to Hobson and McCarley, the distortion and bizarre nature of the dream is not the result of unconscious wishes and subtle psychological factors arising from within the cerebrum, as some such as Freud (1965) have claimed, but appears to be much more of a random and meaningless process. The personal and idiosyncratic aspects of dreams may arise from a matching of specific memories with images or sensations, or with motor commands for movement, resulting from brain stem activation (McCarley, 1983).

Horne (1988) mentions that Siegel, Nienhuis, Wheeler, McGinty and Harper (1981) have found that the FTG cells also fire in a similar way during wakefulness. In fact, this firing seems to be linked to attempted body movements. Horne notes that Vogel (1978) has criticized Hobson and McCarley saying that dreaming may not be caused by a random discharge of FTG cells to the cerebrum as they infer, because he and other researchers have shown that the cerebrum itself plays a crucial role in the initiation and organization of dreams. Their studies have shown that the generation of REM sleep by the FTG cells falls dramatically in cats which have had their cerebrum removed. The cerebrum is not therefore, necessarily the receiver to the FTG cells, but can influence them in return. For Vogel (1978) dreaming appears to occur inside and outside of REM sleep, and also outside the activation of FTG cells.

Dream physiology research may be criticised in that while there are physiological correlates for the generation of dreams these correlates do not account for the content of dreams. In an attempt to address this issue

McCarley and Hoffman (1981) conducted a series of experiments focusing on categories of dream experience which were likely to be congruent with REM sleep physiology. They considered reports of the occurence of movement, sensation and affect, in dreams. They noted that a high level of movement in lower extremities was reported in dreams. This finding parallels the high degree of motor system physiology activation in REM sleep. In contrast, in slow wave sleep, a time of low motor system physiological activation, they found a low level of reported movement in dreams.

Psychological correlates of physiological activation of the visual, auditory and vestibular systems in REM sleep suggest that dream sensory experiences are related to neuronal activity. Neurophysiological correlates of affect are not well established currently. It is, therefore, not possible at present to determine whether there are parallels between psychological intensity of affect in dreams and physiological activation of affective systems in the brain.

3.2 HEMISPHERE ACTIVATION MODEL OF DREAMING

Although not firmly established a significant amount of research implicates the right hemisphere as having a predominant role in the processing and expression of emotion (eg. Davidson & Schwartz, 1976). However, other studies support the involvement of left hemisphere processing of emotion (Tucker, 1981). From a theoretical basis there is the question of whether cognition causes or structures emotion (Lazarus, 1984), or whether emotion has the primary role and cognition is secondary (Zajonc, 1984).

Myers and Smith (1987) in a cerebral processing study found that patterns of hemispheric asymmetry vary in a complex but systematic way depending on the positive or negative nature of the cognition or affect. Their results suggest that cerebral processing occurs predominantly in the left hemisphere. This happens particularly when emotion is positive, but is present for both positive and negative emotions.

Assertions that dreaming occurs in the right hemisphere (Broughton, 1975; Antrobus & Ehrlichman, 1981) because of visual imagery production cannot be substantiated. There is strong support that the left hemisphere is substantially superior on all aspects of visual imagery production (Antrobus, 1987; Ehrlichman, Antrobus & Weiner, 1985) and that there is considerable similarity in dreaming and waking imagery (Greenberg & Farah, 1986).

The available evidence supports a model in which the left hemisphere plays the major role in REM sleep mentation. It is also suggested that the right hemisphere, under conditions of reduced cortical activation, may produce improbable images (that is, images which are relatively independent of the thematic sequences being produced by the right hemisphere), and then communicating the images sporadically to the left hemisphere. The left hemisphere modifies the mentation sequence to incorporate the novel image. According to Seligman and Yellen (1987) there is no suggestion that these are vivid imagery bursts, but rather low resolution images which, because they are out of context, appear to be bizarre.

While Antrobus (1987) does not explain the generation of improbable images by the right hemisphere he does suggest that the thematic coherence of sleep mentation must be produced by a cognitive system guided by motives or goals.

3.3 DUAL IMAGE MODEL OF DREAMING - SELIGMAN AND YELLEN

Seligman and Yellen's 1987 Dual Image model of dreaming is probably to date the most comprehensive psychological model on the structure of dreaming that draws from physiological theories.

The theory postulates that there are three elements that make up the structure of a dream : visual episodes, emotional episodes and the cognitive integration of the first two elements. Like Hobson and McCarley (1977) they suggest that periodic visual hallucinations that occur during each bout of REM sleep may eventuate from pontine triggering in the brain stem and end in the forebrain. Although Hobson and McCarley make no comment about these visual hallucinations, Seligman and Yellen assert that these visual hallucinations are not constrained by the rest of the dream. Therefore one visual burst does not influence the content of the next burst. The content of a visual burst may be defined as vivid, having detail such as size, shape, colour and number and can be scanned. These visual hallucinations are constrained by factors external to the dream.

During a REM bout, PGO waves, which are generated from pontine triggering in the brain stem are said to increase in frequency and intensity

and manifest themselves as bursts of eye movements also known as REM visual bursts or phasic REM. Also associated with the REM bout is REM quiescence or tonic REM. Molinari and Foulkes (1969) investigated the different mental activity occuring in these two states by awakening subjects in each of the states. They found more primary visual experience material (PVE) which is akin to hallucination-like material during bursts of eye movements, and more secondary cognitive experience material (SCE) that is more intellectually based and less visual during REM quiescence. This was confirmed by Bosinelli, Cicogna and Molinari (1974). Hobson, Goldfrank and Snyder (1965) also found that a dream was more likely to be reported during REM when individuals were woken from periods of intense eye movement.

There are also bursts of middle ear muscle activity (MEMA) during phasic REM sleep. This activity is associated with auditory hallucinations.

The second element is the emotional episodes. When these are joined to the visual bursts they create the skeleton of the dream. The emotional episodes stem from the structures of the brain associated with the limbic system. This area of the brain may be responsible for our emotional life and is supposed to be more active during REM sleep that the other phases of sleep. Seligman and Yellen also say that the content of the emotional episodes are relatively unconstrained by the content of the visual bursts or the cognitive synthesis.

The third element is the integrative process. This process synthesizes the visual bursts with the emotional episodes to construct a coherent plot. The process may be dominant during the quiescent period between REM bursts. Thus the dreamer constructs a plot by using the visual modality which is akin to waking visual imagery.

Seligman and Yellen suggest that "integrative activity is ineluctable and occurs concurrently with visual bursts, but is overshadowed by a burst". Since the more salient features of the visual burst will be reported during REM burst awakenings, it is necessary to probe the dreamer about cognitive activity. Conversley, reports collected during REM quiescence tends to find the dreamer reporting cognitive activity because it is more salient. Once again probing the dreamer should result in reports of visual events, since these researchers believe cognitive activity is largely in a visual mode.

In essence Seligman and Yellen's theory states two major lines of thought Firstly, that the primary visual experiences of the dream are subjectively distinguishable from the cognitive integration. Therefore the dreamer is able to distinguish vivid visual material from less vivid material. The primary visual experiences contain hallucinatory vivid material not constrained by the ongoing plot whereas the cognitive integration is less vivid, less bizarre and more continuous and constrained by the plot.

Secondly, the content of the vivid visual material from phasic REM is independent of what preceded it. 'Independent' is defined as discontinuous

with what preceded it, distorted or bizarre. Watson (1972) reported that PIP-REM awakenings produced more bizarre material than non PIP-REM awakenings. This was replicated but only for some individuals by Watson, Bliwise, Friedman, Wax and Rechtschaffen (1978). Similarly Rechtschaffen and Buchigiani (1983) found no significant differences in bizarreness for the vivid material. Importantly, Bliwise and Rechtschaffen (1978) and Rechtschaffen, Watson, Wincor, Molinari and Barta (1972) looked at continuity of images when PIP's occured in NREM sleep. They both found more 'discontinuity' in phasic NREM than in tonic NREM.

Seligman and Yellen postulate that the cognitive component of dream construction cannot act first to constrain either the visual bursts or the emotional episodes. However, they acknowledge there may be some external constraints which render these visual and emotional episodes not entirely independent.

External constraints on dreams include material from our daily lives. That is, day residue from our current emotional concerns and from scenes we have witnessed and people we have known in the past and at present. Seligman and Yellen see these as the most obvious external constraints on visual bursts. A second major constraint on visual bursts are residues more remote than the previous day and probably include recurrent or nonrecurrent material.

Apart from external constraints such as day residue there are also concurrent external constraints which may include internal events such as posture and the state of the viscera. For example, a full bladder may generate a dream sequence of the dreamer desperately needing to urinate; sleeping in a position in which the arm is twisted behind the neck, might contribute to a sequence of events of being strangled.

The forces constraining emotion include current concerns such as wishes, desires, yearnings, conflicts and deprivations (Klinger, 1971), unconscious concerns such as unrecognized conflicts and desires (Freud, 1952) and phylogenetic constraints such as hormonal changes which make sexual settings more likely in dreams (Jung, 1960).

The definition and estimates of the frequency of REM bursts within a REM bout, suggest there are roughly 30 REM bursts in an average bout. Therefore there are about 30 visually vivid episodes. Dream reports however, rarely contain this many separate episodes. The theory suggests two reasons. Firstly, this may be because memory capacity is limited and secondly because synthesis tends to knit many episodes together.

The theory suggests that since remote residue may be common from one night to the next there is a distinct possibility that very similar visual bursts will occur on different nights. The first time such a visual burst occurs, a cognitive integration will be built around it. This cognitive integration is stored and forms part of the remote residue. If this visual burst occurs in a

subsequent dream, it will tend to set off the prior cognitive integration. Seligman and Yellen (1987) suggest that this may account for recurrent dreams.

In conclusion the dual image model of the structure of dreams postulates that the content of visual sensory bursts is independent of cognitive synthesis in dreaming. Therefore each visual burst is independent of the process of cognitive synthesis. This is consistent with Hobson and McCarley's (1977) activation synthesis model.

One of the predictions deriving from Seligman and Yellen's theory is that the vivid images, being generated independently of the cognitive synthesis, should be more surprising than the vague images. Seligman and Yellen (1987) produce evidence from home dream reports in support of their predictions. They also note another possible interpretation of their results is that surprising images will be better recalled and rated as more vivid.

Research to test selective recall of surprising visual scenes based on Seligman and Yellen's theory of dreams was conducted by van den Hout, Zijlstra and Merckelbach (1989). They asked individuals to recall details from a surprising slide embedded in a series of unsurprising slides. Two hundred and thirty-nine subjects were divided into four groups where they watched a series of slides. The subjects were unaware of the number of slides being projected. The theme of the slides were sportswomen and actresses. Group 1 was shown 7 slides all of sportswomen, Group 2 was

shown six slides of actresses and then the last one was of a sportswoman. Group 3 was shown seven slides of actresses, six of whom were shown to the second group. Group 4 was shown six slides of sportswomen and the last one was of an actress. The first six slides were the same as those shown to the first group.

Subjects were asked a number of questions: 1) if there was something surprising about the last slide, 2) after how many slides had the theme become clear and 3) if they knew what slide had been presented last. Subjects then scored three visual analogue scales asking about vividness, colourfulness and the degree to which the slide was remembered in detail. They were also asked about colours which had been seen and details they were able to remember from the last slide.

The data showed that unexpected visual scenes were better attended to or at least better recalled than expected scenes. Surprisingness of visual scenes appears to be sufficient to explain good recall of such scenes.

The data appeared to support the Von Restorff effect which refers to the finding that an isolated item in a set of homogenous items is better recalled than one of the homogeneous items (Von Restorff, 1933). Green's (1956) research which showed that deviant stimuli are better remembered because of the element of surprise in the deviant stimuli, was also supported. The data also are consistent with Gray's (1982) theory of the Behaviour Inhibition System which says that novel (i.e. unexpected) stimuli, will interrupt

ongoing behaviour and initiate increased attention and environmental scanning.

The study by van den Hout, Zijlstra and Merckelbach (1989) does not contribute directly to the psychology of dreams or test the merits of Seligman and Yellen's theory, but does suggest ways of testing the visual content of dream reports.

3.4 THE PRESENT ORIENTATION

Seligman and Yellen (1987) postulate two types of imagery. The vivid imagery, generated by the pontine brainstem activity, is said to be unconstrained by the plot. These images are therefore surprising or unexpected. The other type of imagery, the vague imagery, is said to be generated by the process of cognitive synthesis. It is therefore constrained by the plot and is expected or less surprising.

The present orientation divides the hypotheses into three groups for convenience of explanation and discussion:

(1) Hypotheses concerning differences in vividness or clarity of imagery between tonic and phasic REM awakenings.

1(a) A vivid image identified in a dream report collected after waking the subject from a phasic REM bout is more likely to be at the end of the dream while the vague image will appear earlier in the dream report. Conversely, a vivid image identified in a dream report collected after waking the subject

from a tonic REM bout is more likely to appear earlier in the dream while the vague image will appear closer to the end of the dream report. This hypothesis seeks to demonstrate the relationship between vividness of imagery and awakenings from tonic or phasic REM.

1(b) Vivid images will be rated by the dreamer as much clearer than vague images. This hypothesis was included to confirm explicitly the phenomenological distinction between vague and vivid images.

1(c) Assuming that vivid images occur closer to the end of a dream when awakening from phasic REM sleep and vague images are closer to the end when awakening from tonic REM sleep (Hypothesis 1a), and assuming also that vividness decreases over time, it is predicted that the vivid image from a phasic awakening will be rated as clearer than a vivid image from a tonic REM awakening. Conversely, a vague image from a phasic REM awakening will be rated as less clear than a vague image from a tonic REM awakening.

(2) Hypotheses concerning differences in surprisingness of vivid and vague images in relation to the preceding plot.

2(a) A vivid image identified by the dreamer will be more surprising in terms of the preceding plot than a vague image. Independent judges should rate their surprisingness as different since a vivid image is a visualization with a non-plot-related theme and a vague image has a plot-

related theme.

2(b) A vivid image from one phasic dream report when compared to a vivid image from another phasic dream report collected on the same night, from the same subject will be rated to be equally surprising with respect to either of the preceding plot. Independent judges should rate both these images as equally surprising since they are non-plot-related events.

(3) Hypotheses concerning incorporation of events from the previous day in dream imagery.

3(a) That the dream reports from each subject will be rated as having more direct incorporation of imagery related to their own (real) diary record than to the diary record of a randomly matched subject (other). Independent judges should rate dream reports as containing more imagery which refers directly to one diary record than another, since only one diary record belongs to that subject. Furthermore there will be more direct incorporation of imagery related to their own diary record in both vague images and vivid images from each dream report.

3(b) The extent of incorporation of diary material will be the same for vague and vivid images. This result is not clearly predicted by Seligman and Yellen (1987), though it may be relevant to distinguishing a dual image generation process from a single process.

CHAPTER FOUR

METHOD

When I placed my head on my pillow,
I did not sleep, nor could I be said to think.
My imagination, unbidden, possessed and
guided me, gifting the successive images
that arose in my mind with a vividness
far beyond the usual bounds of reverie.
- Mary Shelley, *Frankenstein*, 1831.

4.1 SUBJECTS AND PROCEDURE

There were 18 subjects ranging from 14 to 33 years of age who participated in this experiment but data from only 15 subjects, 5 males and 10 females were used because three (3) subjects for various reasons were unable to sleep satisfactorily within the laboratory environment. The subjects were unaware of the experimental hypotheses but were informed that the study was interested in the collection of dream reports to further understand certain existing dream theories.

After being informed of the experimental procedures each subject volunteered to participate according to their own judgements of being able to sleep in a different environment compared to his or her usual home environments. Most subjects who volunteered had already participated in other experiments of a similar nature or had an interest in the study of dreams. No subject was taking prolonged medication or short term drugs such as alcohol as this may have altered the nature of REM sleep. Subjects were paid a small fee for participating in this experiment.

Subjects were assured that all dreams reports collected would be considered confidential, and would be used strictly for this study.

Subjects were asked to sleep in the laboratory for one night only. An adaptation night was not deemed necessary as the experiment would not be confounded if dream reports had an over-representation of the laboratory setting. All subjects were woken during each REM bout which lasted more than five minutes and asked to recall their dream. They were all able to recall and report at least three dreams during their session.

The subjects who volunteered to participate in this study were asked to come to the University of Tasmania, Psychology Department Sleep Laboratory. They were told to arrive about an hour and a half before their normal bedtime to facilitate preparation for electrode attachment and also to write a report of their "days events, thoughts and concerned emotions" which would later be needed by the judges to rate for surprisingness of dreams collected during the tonic and phasic periods of the REM cycle. They were asked to bring with them the necessary clothing and extras such as their own bedding to ensure a pleasant night's sleep.

4.2 COLLECTION OF DREAM REPORTS

The subjects in this study were aroused from tonic and phasic REM bouts and asked to recall their dreams. The criteria for defining tonic and phasic REM were adopted from Molinari and Foulkes (1969), who interpreted bursts of eyemovements during stage REM as reflecting phasic activation compared to tonic periods characterised by REM quiescence. Phasic bursts last about 2-9 seconds, while tonic periods extend from about 16-120 seconds. Examples of polygraph records showing tonic and phasic REM are shown in

Appendices A and B. The tonic and phasic distinctions were checked by two experienced sleep researchers. They were also blind to the conditions. REM bouts were used only if both judges agreed that the criteria had been met.

Subjects were not disturbed during the first 5 minutes of each REM period but were then aroused from either tonic (ocular quiescence) or phasic (ocular motility) and asked to recall their dream. This procedure was adopted on the basis of a study done by Kramer, Czaya, Arand and Roth (1974) who showed that dream intensity fluctuated and was highest at the 5 minute interval and then again at the 10 minute interval and 30 minute interval. The 5 minute interval was judged as most appropriate since dream reports were collected from all REM periods including the first which is generally quite short.

The subject was awakened only once during each REM period of the night. Upon awakening, the subject was told:

> "You have been dreaming. Just relax yourself and try to remember what you were just dreaming about. When you remember could you please tell me about your dream."

Each subject recalled their dream reports into a hand held portable tape recorder while the experimenter also transcribed onto paper, in case words were inaudible or misunderstood due to the subject's slurring of speech in his or her state of somnolence. After the subject had completed their recollection, the experimenter asked, "what was the last most vivid image in your dream and how would you rate it on this ten point scale" where 1 is very clear and 10 is very unclear. Subjects were also asked to rate "the most vague image" in their dream on the same ten point scale.

If the subject was unable to recall a dream, then they were prompted to "relax" and "try to remember". If this was unsuccessful then the subject was asked to retire until the next awakening.

All tape-recorded dream reports were transcribed and typed for each subject. This was done to eliminate bias on the part of the judges.

In total there were 45 dream reports collected. However, to test hypothesis 2, only 33 dream reports were used to satisfy the criterion of at least ten words prior to the identified image. This was deemed necessary since the study was interested in comparing vivid and vague images to a preceding plot. Some dream reports were not counted because the images appeared at the beginning of the dream.

4.3 SLEEP RECORDINGS

In order to determine the assessment of sleep states a standardised procedure such as that set out by Rechtschaffen and Kales (1968) was used. One exception to these procedures is that a single bipolar electro-oculogram was recorded rather than two monocular channels (Wells, Allen & Wagman, 1977). A total of eight electrodes was used. The electroencephalogram (EEG) recording was made by placing an electrode at position C3, the prefrontal EEG and referencing it to the subjects' right ear A1. A spare electrode was placed at FP2 which refers to the frontal or upper forehead region close to the hair line and referenced to the subjects' left ear, A2 in case of problems with the main electrode. Each site for electrode placement was cleaned with alcohol in order to remove the natural oils from the skin of the subject. Electrode paste was then applied for a more effective electrode skin contact.

The electro-occulogram (EOG) was recorded by placing electrodes above and below the outer canthi of the right eye-A1 and left eye-A2.

The electromyogram (EMG) was recorded by placing electrodes located at the submental area medial to the mandible on both sides of the chin. This procedure of EMG electrode placement was consistent for all subjects.

The electrode on the scalp was secured with colloidon and gauze, while the remaining electrodes were attached with stripes of surgical tape. After completing all electrode placements, the electrodes were grouped and taped together to form a single lead at the back of the neck in order to prevent discomfort during the night.

The resistance of all electrodes was tested and kept below 10K ohms, and the electrodes were connected via a plugboard to a Beckman R511a eight channel polygraph recorder, which produced a pen-chart recording of each of the three measures. A paper speed of 10mm/sec was used.

CHAPTER FIVE

RESULTS

But I was well
Upon my way to sleep before it fell
And I could tell
What form my dreaming was about to take
Magnified apples appear and disappear,
Stem end and blossom end.
And every fleck of russet Showing clear.
- Robert Frost
"After Apple-Picking"

A total of 45 dream reports were collected, three from each of the fifteen subjects. One report was from tonic and two were from phasic REM.

There were three main groups of hypotheses being tested in this study. Two of these were tested by getting four independent judges, who were unaware of the hypotheses to rate dream reports which had been collected from tonic and phasic REM bouts. All dream reports had both the last vivid and the most vague image which had been identified by the dreamer and had also been rated on a ten point scale where 1 = very clear and 10 = very unclear.

A rating scale of surprisingness of images with respect to the preceding plot of the dream report was used to obtain scores which could then be used to test the second major hypothesis. The rating scale was accompanied by instructions to the raters.

To confirm the association between vivid visual imagery and phasic REM sleep postulated in hypothesis 1(a) a two factor repeated measures analysis of variance was performed on proximity of vivid and vague images to the point of awakening as indicated by a count of words to the end of the dream. Means and standard deviations of word counts are shown in Table 5.1.

Table 5.1 Word count from the vivid or vague image to the end of the dream for awakenings from tonic or phasic REM sleep.

	TONIC		PHASIC	
	Mean	S.D.	Mean	S.D.
Vivid Image	35.3	27.1	42.9	53.0
Vague Image	11.3	21.5	70.5	58.5

The relationship between image type and REM phase was confirmed by the significant interaction [$F(1,14) = 32.34$, $p = 0.0001$]. Furthermore post hoc tests indicate that for tonic awakenings the vague image is significantly closer to the end of the dream ($t = 2.9$, $df = 14$, $p < 0.05$) whereas for phasic awakenings the vivid image is significantly closer to the end of the dream ($t = 5.32$, $df = 14$, $p < 0.0001$).

When subjects were woken and asked to recall their dream, they also identified and rated the last most vivid image in their dream and the most vague image on a ten point scale where 1 = very clear and 10 = very unclear. All dream reports collected from each of the 15 subjects from both the tonic and phasic REM bout were used in the final analysis. Means and standard

deviations are shown in Table 5.2.

Table 5.2 Means and standard deviations of image clarity for subjects awakened from tonic and phasic REM sleep (n=15).

	TONIC		PHASIC	
	Mean	S.D.	Mean	S.D.
Vivid Image	3.80	0.77	2.33	0.76
Vague Image	8.10	0.91	8.53	0.44

Note: 1 = very clear, 10 = very unclear.

A two factor repeated measures analysis of variance shows the expected main effect for differences in ratings of clarity between vivid and vague images as postulated in hypothesis 1(b) [$F(1,14) = 638.00$, $p = 0.0001$].

Hypothesis 1(c) is supported by the significant interaction between image type and REM phase for ratings of clarity [$F(1,14) = 19.54$, $p = 0.001$]. Post hoc tests show significantly greater clarity of vivid images recalled following phasic REM compared to vivid images recalled after waking from tonic REM ($t = 4.62$, $df = 14$, $p<0.001$). There was a trend in the predicted direction for vague images recalled after phasic awakenings to be rated as less clear than vague images recalled after awakenings made from tonic REM ($t = 1.78$, $df = 14$, $p = 0.097$).

These findings on image clarity and the proximity of vivid and vague images to the point of awakening from tonic or phasic REM sleep are

consistent with previous studies of tonic/phasic differences (e.g., Molinari & Foulkes, 1969).

The second group of hypotheses concern the surprisingness of vague and vivid images. In each case four independent judges rated dream reports which were typed to the end of either the vague or vivid image. The images were typed in bold italics print to distinguish them from the plot. The judges were asked to rate the phrase which had been italicized, for surprisingness or unsurprisingness in relation to the preceding plot. They were asked to use a scale where 1 = very surprising and 5 = very unsurprising (see Appendix C). The correlation coefficents for inter-rater reliability were generally low and ranged from 0.30 to 0.61. All correlations for inter-rater reliability are shown in Appendix F.

In hypothesis 2(a) it was predicted that a vivid image identified by the dreamer would be more surprising in terms of the preceding plot than a vague image. Forty dream reports were rated where each dream report appeared twice, once with a vague image and once with a vivid image. A minimum of ten (10) words before any identified image was defined as a plot. Some dream reports were not included as they did not meet this requirement.

The means and standard deviations of the ratings for surprisingness of vivid and vague images in relation to the preceding plot were ($\bar{x}$ = 3.640; S.D. = 0.938) and ($\bar{x}$ = 3.583; S.D. = 0.786) respectively.

A two-tail probability t-test for the mean judges responses did not show a significant difference in surprisingness between vivid and vague images at

the 5 percent level of significance ($t = -0.23$, $df = 38$, $p = 0.818$).

The results do not provide support for the predicted hypothesis.

In hypothesis 2(b) it was postulated that a vivid image from one phasic dream report when compared to a vivid image from another phasic dream report collected on the same night, from the same subject will be rated to be equally surprising with respect to either of the preceding plots. This relates to the Seligman and Yellen (1987) theory in which vivid images are independent of the preceding plot, apart from external constraints such as day residue, distant residue or current life concerns which are constant.

Since each subject had two phasic REM dream reports this was tested by interchanging the vivid images from the two phasic REM dream reports. Once again a minimum of ten (10) words before any identified image was defined as a plot. There were seven subjects whose data satisfied these requirements for both phasic dream reports.

Four independent judges were presented with each dream image typed in bold italics print to distinguish them from the plot. The judges were asked to rate the phrase which had been italicized for surprisingness or unsurprisingness in relation to the preceding plot. They were asked to use a scale where 1 = very surprising and 5 = very unsurprising (see Appendix C). The correlation coefficients for inter-rater reliability were moderately high and ranged from 0.47 to 0.78.

The means and standard deviations of raters' responses of surprisingness when vivid images were interchanged between phasic REM reports so that

some images belonged to the dream report and others did not belong were ($\bar{x}$ = 3.625; S.D. = 1.109) and ($\bar{x}$ = 2.125; S.D. = 0.705) respectively.

A two factor repeated measures analysis of variance was performed on the data, the factors being belonging (image belongs or does not belong in the dream report) and dream (first or second). The effect of belonging was marked and consistent for all subjects, achieving statistical significance at the one per cent level [$F(1,6) = 15.75$, $p = 0.0023$]. Accordingly it may be concluded that an image was less surprising in the context of its own dream narrative.

The results do not provide support for the Hypothesis 2(b) as a significant difference was found when the original vivid image from one phasic dream report was replaced by another vivid image from another phasic dream report collected on the same night. In an attempt to elucidate this phenomenon, it was decided to repeat the judgements and analysis using images stripped of identifying information in the form of verbal cues where the same word was used in the image and the preceding narrative.

An example of a dream report where the vivid image was stripped of it's verbal cues:

I was doing some kind of experiment like this. I did not understand what I was supposed to be doing. I went back to another room. ***People were using words which told me about the experiment.***

The vivid image the subject supplied was:

People were using words which told me about the experiment.

This became:

People were using words which told me about it.

In this case the rationale is that the vivid image may be of people telling me about something which is transformed by the cognitive synthesis or secondary elaboration to people telling me about the experiment. The word "experiment" could then provide a verbal cue which would greatly reduce the rating of surprisingness in terms of the preceding plot.

Since each subject had two phasic REM dream reports, this prediction was tested by interchanging and stripping the vivid images from the two phasic REM dream reports. Once again a minimum of ten (10) words before any identified image was defined as a plot. The images were typed in bold italics print to distinguish them from the plot. The judges were asked to rate the phrase which had been italicized for surprisingness or unsurprisingness in relation to the preceding plot. They were asked to use a scale where 1 = very surprising and 5 = very unsurprising (see Appendix C). The correlation coefficients for inter-rater reliability ranged from 0.64 to 0.78.

Means and standard deviations of ratings of surprisingness for images which belonged in the dream report were ($\bar{x}$ = 3.590, S.D. = 1.340), compared to the images from another phasic dream ($\bar{x}$ = 2.070, S.D. = 0.820). (Lower ratings indicate greater surprisingness). Again the difference in means was statistically significant [$F(1,6) = 6.94$, $p < 0.05$]. Although the difference is slightly diminished by the removal of the most conspicuous verbal cues, it is clear that the preceding narrative contains contextual information which relates more naturally to the actual vivid image than to the transposed image from the other phasic REM dream.

The third group of hypotheses concern the incorporation of diary material from previous days events in the dream imagery.

Hypothesis 3(a) predicted that dream reports from each subject would be rated as having more direct incorporation of imagery related to their own (real) diary record than a diary record from another subject (other).

Three independent judges were presented with three dream reports from each subject and two diary records. One diary record belonged to the subject and the other was a diary record from another subject obtained by random permutation of diaries without permitting correct matches. The first dream report was from a tonic REM awakening and the other two reports were from phasic REM awakenings. Each dream report had two highlighted images. The vivid image was highlighted in pink and the vague image was highlighted in blue.

The judges were asked to rate (1) each dream report, and (2) each of the highlighted images after having read diary record one. The judges used a 5 - point rating scale ranging from 0 (No indication of diary events or thoughts in dream report or imagery) through 1 (Some indication of diary events or thoughts in dream report or imagery) to 4 (Most or all of the dream report or imagery refers directly to the diary events). This procedure was then repeated for diary record two (see Appendix D). The correlation coefficients for inter-rater reliability ranged from 0.40 to 0.46.

The means and standard deviations are shown in Table 5.3.

Table 5.3 Means and standard deviations for incorporation of diary contents in dream records (n=15).

	Own Diary		Randomly Matched Diary	
Dream record	Mean	S.D.	Mean	S.D.
Whole Dream	0.842	0.644	0.115	0.142
Vivid Image	0.425	0.563	0.033	0.076
Vague Image	0.409	0.359	0.105	0.136

A two factor within-subjects multivariate analysis of variance (MANOVA) was performed on the dependent variable, degree of incorporation. Independent variables were Diary Record (belonging to the subject or not belonging to the subject), and dream record (whole dream record, vivid image or vague image).

The hypothesis of greater incorporation of information from the subjects own diary than a randomly matched diary was confirmed [Wilks Lambda = 0.458, $F(1,14) = 16.542$, $p = 0.0012$]. Post hoc t-tests confirmed the effect separately for whole dream reports ($t = -4.33$, $df = 14$, $p < 0.01$), vivid images ($t = 2.91$, $df = 14$, $p = 0.05$) and vague images ($t = 3.02$, $df = 14$, $p < 0.01$).

Hypothesis 3(b) predicted that there would be no difference in the incorporation of the subjects own diary material in a vivid image and a vague image This was tested by a t- test, and the difference was clearly nonsignificant ($t = 0.14$, $df = 14$, $p = 0.89$).

In summary, there was significant incorporation of material from the previous day in dream reports, but no difference in the extent of incorporation in vague and vivid images.

CHAPTER SIX

DISCUSSION

When I say, My bed shall comfort me,
my couch shall ease my complaint,
then thou scarest me with dreams,
and terrifiest me through visions,
so that my soul chooseth strangely,
and death rather than life.
- Book of Job

Seligman and Yellen (1987) have made a significant contribution to dream theory by developing a dual image model of dream production which provides an alternative to cognitive theories. The model not only postulates two types of imagery with different characteristics deriving from the processes by which they are generated (thereby leading to specific and testable hypotheses) but also addresses the issue of scene shifts and thematic discontinuities which are largely ignored by cognitive theories.

Following the proposal of Seligman and Yellen (1987) the present study was designed to investigate the types of imagery associated with the two phases of REM sleep, that is tonic and phasic REM. Seligman and Yellen (1987) postulated two types of imagery. The first type, the vivid imagery, occurs during visual bursts which possibly originate by periodic pontine triggering. This imagery is said to be associated with non-plot-related events and therefore consists of thematically surprising scenes.

The other type of imagery, the vague imagery, is said to be generated by the process of cognitive synthesis. The images are therefore plot-related and are

expected or less surprising. Vague imagery is associated more with tonic REM, which has less visual or auditory imagery. This association of vivid imagery with phasic REM is derived from the work of Molinari and Foulkes (1969) and Pivik, Halper and Dement (1969), who found that there was a greater incidence of visual or auditory imagery in dream reports collected during phasic REM. Subjects woken during a REM burst (phasic) reported more 'primary visual experience' (PVE) material which is very much like a visual hallucination while subjects woken from REM quiescence (tonic) reported more 'secondary cognitive elaboration' (SCE) material which is more intellectual and has less visual mentation.

Seligman and Yellen's (1987) theory of dream construction places the dreamer in an active position in relation to the dream. The dreamer actively integrates the visual and emotional material as it occurs and constructs a story line. The strong version of their theory states that visual bursts and the emotional tone of a dream are unconstrained by the cognitive synthesis process. Weaker versions of their theory include modification of the emotion while the dream is being synthesised and external constraints on the visual bursts. Thus, they propose that it might be possible for the cognitive integration to weakly modify the "arousal-emotion that arises from the limbic-autonomic activity and make(s) it conform better to the plot" (1987, p. 20) and that the visual bursts might not be wholly independent as they could be constrained by the day residue, remote residue and postural or visceral conditions (Seligman & Yellen, 1987).

This study examined three main groups of hypotheses related to Seligman and Yellen's (1987) theory of dream construction: (1) The differences in vividness or clarity of imagery between tonic and phasic REM, (2) The

differences in surprisingness of vivid and vague images in relation to the preceding plot, and (3) Incorporation of events from the previous day in dreams and comparison of incorporation in vague and vivid imagery.

The first major hypothesis in this study used two techniques [of analysis] to show differences in vividness or clarity of imagery between tonic and phasic REM. A word count to the end of the dream from the vivid and vague images showed that in phasic REM reports, vivid images appeared towards the end of the report while vague images appeared early in the report. It was found that in tonic REM reports, vivid images appeared early in the report while vague images appeared towards the end of the report.

Secondly, a rating scale for clarity of image was used where 1 = very clear and 10 = very unclear. Subjects woken from phasic REM and asked to recall and rate the last most vivid image, rated this image as clearer than a vivid image recalled from tonic REM. Vague images from a phasic REM report were rated as less clear than vague images from a tonic REM report, although this difference was not statistically significant.

These findings on clarity of imagery and the proximity of vivid and vague images to the point of awakening from tonic or phasic REM sleep are consistent with previous studies of tonic/phasic differences (Molinari & Foulkes, 1969). There are however, some methodological differences in that Molinari and Foulkes asked subjects to recall and rate the last image whereas in this study subjects were asked to recall and rate the 'last most vivid image' and 'most vague image'. This procedure was adopted as more appropriate to the needs of the present study since the testing of the hypotheses about surprisingness required identification of vivid and vague

images. It is inappropriate to simply use the last image identified in the dream following a tonic or phasic awakening as the correlation between REM phase and reported vividness is not perfect, and any failure of recall by subjects in a fairly somnolent condition could bias the subject towards ending a report with a vivid image, even from a tonic REM awakening.

The core of Seligman and Yellen's (1987) dual image theory is the postulation of an independent process for the generation of vivid visual imagery which is largely unrelated to the preceding plot. The methodology used to test this hypothesis was similar to Seligman and Yellen in that vivid and vague images were judged for surprisingness in the context of the original dream report. Different findings were, however, obtained, in that there was almost no difference in ratings of the surprisingness of vague and vivid images. This finding stands in contradiction of the dual image theory though there is need for some caution in interpreting these results because of the low inter-rater reliability. This outcome is, however, consistent with the second finding that even the vivid images are context related, being judged less surprising than vivid images from another phasic REM dream of the same night, when related to the same preceding narrative. Thus, contrary to the Seligman and Yellen (1987) theory there is evidence that vivid images are at least partially constrained by a process of cognitive construction in the formation of the dream, and there is no evidence of any differences in the cognitive constraint on vague and vivid images.

The results differ from those reported in the 1987 study by Seligman and Yellen with students' dreams collected at home. This method of dream collection is generally regarded as less reliable than laboratory dream collection, as Seligman and Yellen themselves acknowledge. Moreover the

use of laboratory dream collection permits the testing of the independence hypothesis by transposing images from different phasic REM periods on the same night, thus controlling for the processes involved in day residue, distant residue and current life concerns which are used by Seligman and Yellen (1987) to qualify the notion of strict independence of phasic visual images. These processes apply equally to phasic REM dreams on the same night and lead to the prediction that such images should be equally surprising in terms of a preceding plot. This hypothesis is contradicted by the findings of the present study even when the images are stripped of the most conspicuous verbal cues. In summary the ratings of surprisingness are consistent with a process of cognitive construction which applies equally to vague and vivid images.

An example from a dream report collected during phasic REM which may help to demonstrate the difficulties experienced by the judges when distinguishing vivid and vague images from a given plot:

> *It was about going to an ear specialist for an ear ache. He was saying to me that he's interested in everyone's ears. He was also talking about his interest in cars. He said that its usually the old ones that have problems. I was talking to the Specialist as the Royal Hobart Hospital.* ***The room was strange (Vague).*** *He then said that he'd have to check my veins to see if there was a problem there. He checked my veins and found no problem.* ***The doctor's face was very clear (Vivid).*** *He was a very specific ear specialist who was concerned with the outer part of the ear rather than the inner ear.*

The vague and vivid images in this dream report were both rated by the judges to be very unsurprising in terms of the preceding plot.

Another example from a dream report collected during tonic REM:

> *Dreamt that it was going to be the new year soon and I was standing in front of a pile of washing and* ***someone said that I have to wear my grey trousers for tomorrow*** **(Vivid).** *I was folding towels and other washing. I was conscious of having a musty body odour.* ***Someone was going to either England or Scotland*** **(Vague).**

The vague and vivid images in this dream report were both rated by the judges to be very surprising in terms of the preceding plot.

Another methodological problem associated with distinguishing an image from the rest of the plot which is applicable to hypotheses one and two, relates to the recall of images by the dreamer. It seems that a series of changes potentially occurs following the dream which may modify the vivid imagery. It is possible that by the time a vivid image is identified it has undergone a level of interpretation which modifies it to fit the cognitive synthesis so it appears to be constrained by the preceding plot. Therefore, some of the verbal cues may remain within the image when it is extracted from the dream by asking the dreamer to identify the last most vivid image and the most vague image.

To take account of this possibility the data were reanalysed after "stripping" images of words which were repeated from the preceding narrative. Even after removing such cases the naturally occurring image was judged significantly less surprising in the context of the preceding narrative than a vivid image from another phasic REM report on the same night.

The third group of hypotheses concerned incorporation of previous day's events. The existence of external constraints on dreams in the form of day

residue was supported in the third major hypothesis by the finding that there was more direct incorporation from the subjects' own diary record than from a diary of a randomly matched subject. There was also more direct incorporation of events in both vivid and vague imagery from the subjects' own diary record than the diary record of another subject. There was, however, no differential process in incorporation between vivid and vague images. Insofar as processes leading to incorporation of recent events are involved, there is no differentiation between vivid or vague images and consequently no evidence for a dual image production model.

One of the main methodological difficulties in this study was the definition of visual bursts. Seligman and Yellen (1987) used the Molinari and Foulkes (1969) research about visual hallucinations in REM periods and equated the bursts of REM activity with a visual burst. Likewise they have equated the secondary activity of REM quiescence with cognitive visual events. The scoring of tonic and phasic REM, though aided by the criteria suggested by Seligman and Yellen (1987) involved a degree of subjectivity in deciding what constitutes a phasic eye movement as distinct from a less dramatic "rolling" eye-movement. The distinction between certain types of eye-movements must take into account both the amplitude and the sometimes ambiguous distinction between what may be considered to be acute or obtuse movements.

The present study has several strengths. The major strength is that unlike the Seligman and Yellen (1987) experiments, subjects reported their dreams in a laboratory setting. This allows, for less influence and more constraint by the cognitive synthesis over the visual and emotional content of the dream. Secondly, retelling a dream after being awakened from a REM bout

is preferable to next day reporting since the latter may impose another process of integration which modifies the unexpectedness of the visual bursts.

The results of this study are not consistent with the strong or weaker versions of the Seligman and Yellen (1987) theory. (The weaker versions of Seligman and Yellen's theory allow for constraints on the visual bursts by day residue and remote residue). The present results implicate a process of cognitive construction in the formation of vivid as well as vague images.

These results are not inconsistent with the hemisphere activation model (Davidson & Schwartz, 1976; Antrobus & Ehrlichman, 1981) in which the left hemisphere plays the major role in REM mentation. Antrobus and Ehrlichman (1981) also suggests that the right hemisphere may produce improbable images and communicate the images sporadically to the left hemisphere. The left hemisphere modifies the mentation sequence to incorporate the novel image. There is no suggestion that these images are vivid imagery bursts but rather low resolution images which because they are out of context, appear to be bizarre. Further research would be required to investigate the unique features of this model.

Despite methodological difficulties this study has provided evidence for constraint by the process of cognitive synthesis in the formation of vivid visual images as well a vague images. This suggests that more than hindbrain activation may be needed to account for the formation and integration of dream imagery.

REFERENCES

Adam, K. (1980). Sleep as a restorative process and a theory to explain why. In *Progress in Brain Research.* Adaptive Capabilities of the Nervous System, **Vol.53** by P.S. McConnell, G.J. Boer, H.J. Ramijpu, N.D. Van De Poll & M.A. Corner. Amsterdam, Elisevier/Nth. Holland Biomedical Press. pp.289-305.

Antrobus, J.S. (1987). Cortical hemisphere asymmetry and sleep mentation. *Psychological Review,* **94**, 3, 359-368.

Antrobus, J.S., Antrobus, J.S. & Fisher, C. (1965). Discrimination of dreaming and non-dreaming sleep. *Archives of General Psychiatry,* **12**, 395-401.

Antrobus, J.S., Arkin, A.M., & Toth, M.F. (1970). The effects of REM period deprivation on sleep mentation. *Psychophysiology,* **7**, 332.

Antrobus, J.S., Singer, J.L. & Greenberg, S. (1971). Looking with the mind's eye: Experimental studies of ocular motility during daydreaming and mental arithmetic. *Transactions of the New York Academy of Science,* **33**, 694-709.

Antrobus, J. & Ehrlichman, H. (1981). The dream report: Attention, memory, functional hemispheric asymmetry and memory organization. *Sleep Dreams and Memory,* In Fishbein, W. (Ed.) Spectrum Publications Inc.

Arkin, A.M., Antrobus, J.S., Toth, M.F. & Baker, J. (1968). The effects of chemically induced REMP deprivation on sleep vocalization and NREM mentation - An initial exploration. Paper presented at the meeting of the Association for the Psychophysiological Study of Sleep, Denver, March, 1968. *Psychophysiology,* **5**, 217.

Aserinsky E. (1967). Physiological activity associated with segments of the rapid eye movement period. In Kety, S., Evarts, E. & Williams, H.L. (Eds.) *Sleep and Altered States of Consciousness.* Baltimore: Williams & Wilkins.

Aserinsky, E. (1971). Rapid eyemovement density and pattern in the sleep of normal young adults. *Psychophysiology,* 8, 361-375.

Aserinsky, E. (1973). Relationship of rapid eye movement density to the prior accumulation of sleep and wakefulness. *Psychophysiology,* **10**, 545-558.

Aserinsky, E. & Kleitman, N. (1953). Regularly occurring periods of eye motility and concomitant phenomena during sleep. *Science,* **118**, 273.

Aserinsky, E. & Kleitman, N. (1955). Two types of ocular motility occurring in sleep. *Journal of Applied Physiology,* 8, 1-10.

Aserinsky, E. (1971). Rapid eye movement density and pattern in the sleep of normal young adults. *Psychophysiology,* 8, 361-375.

Astic, L. & Jouvet-Mounier, D. (1969). In Saunders, N.A. & Sullivan, C.E., (Eds.) (1984). *Sleep and Breathing.* Lung Biology and Health and Disease. New York:Marcel-Dekker.

Berger, R.J. (1969). Oculomotor control : A possible function of REM sleep. *Psychological Review,* **76**, 144-164.

Berger, R.J. & Oswald, I. (1962b). Eye movements during active and passive dreams. *Science,* **137**, 601.

Bliwise, D. & Rechtschallen, A. (1978). Phasic EMG in human sleep : III Periorbital potentials and NREM mentation. *Sleep Research,* 7, 58.

Bosinelli, M., Cicogna, P. & Molinari, S. (1973). The tonic phasic model and the feeling of self-participation in different stages of sleep. Unpublished manuscript. Italy. Institute of Psychology of the Medical Faculty of the University of Bologna.

Bosinelli, M., Cicogna, P. & Molinari, S. (1974). The tonic-phasic model and the feeling of self-participation in different stages of sleep. *Italian Journal of*

Psychology, **1**, 35-36.

Brooks, O.C. (1968). Waves associated with eye movement in the awake and sleeping cat. *Electroencephalography and Clinical Neurophysiology,* **24**, 532-541.

Broughton, R.J. (1975). Biorhythmic variations in consciousness and psychological functions. *Canadian Psychology Review,* **16**, 217-39.

Brown J.N. & Cartwright, R.D. (1976). Subjective indications of NREM dreaming. *Sleep Research,* **5**, 114.

Brown, J.N. & Cartwright R.D. (1977). Subject versus experimenter elicited dream reports : Who knows best? *Sleep Research,* **6**, 119.

Carroll, D., Lewis, S.A. & Oswald, I. (1969). Effect of barbiturates on dream content. *Nature,* **223**, 865-866.

Cartwright, R.D. (1977). *Night Life.* New Jersey: Prentice-Hall.

Cartwright, R. (1986). Affect and dream work from an information processing point of view.*Journal of Mind and Behaviour,* **7**, (2&3), 411-428.

Cartwright R.D., Lloyd, S. & Trenholm, I. (1982). Dream differences during divorce and after in moderately and highly depressed women. *Sleep Research,* **11**, 103.

Crick, F. & Mitchison, G. (1983). The function of dream sleep. *Nature,* **304**, 111-14.

Davidson, R.J. & Schwartz, G.E. (1976). Patterns of cerebral lateralization during cardiac biofeedback versus the self regulation of emotion: sex differences. *Psychophysiology,* **13**, 62-68.

Delorme, F., Jeannerod, M. & Jouvet, M. (1965). Effects remarquables de la reserpine sur l'activite EEG phasique ponto-geniculo-occipitale, Comptes *Rendus des Seances de la Societe de Biologie,* **159,** 900-903.

Dement, W.C. (1960). The effects of dream deprivation. *Science,* **131,** 1705-1707.

Dement, W.C. (1969). The biological roles of REM sleep. In A. Kales (Ed). *Sleep physiology and pathology.* Philadelphia : Lippincott, p.245-265.

Dement, W.C., & Kleitman, N. (1957). The relation of eye movements during sleep to dream activity : An objective method for the study of dreaming. *Journal of Experimental Psychology,* **53,** 339-346.

Dement, W.C., Khan, E. & Roffwarg, H.P. (1965). The influence of the laboratory situation on the dreams of the experimental subject. *Journal of Nervous and Mental Disease,* **140,** 119-131.

Dement, W., Zarcone, V., Ferguson, J., Cohen, H., Pivik, T. & Barchas, J. (1969). Some parallel findings in schizophrenic patients and serotonin-depleted cats. In Sankar, D.V. S. (Ed.) *Schizophrenia: Current concepts and research.* Hicksville, New York: PJD Publications.

Domhoff, B. & Kamiya, J. (1964). Problems in dream content study with objective indicators: 1. A comparison of home and laboratory dream reports. *Archives of General Psychiatry,* **11,** 519-524.

Drucker-Colin, R.R., de Gomez-Puyou, M.T., del Carmen Gutierrez, M. & Dreyfus-Cortes, G. (1980). Immunological approach to the study of neurohumoral sleep factors: effects on REM sleep of antibodies to brain stem proteins. *Experimental Neurology,* **69,** 563-575.

Drucker-Colin, R.R. (1981). Neuroproteins, brain excitability, and REM sleep. *Advances in Sleep Research,* **6,** 73-94.

Ehrlichman, H., Antrobus, J. & Weiner, M. (1985). EEG Asymmetry and sleep mentation during REM and NREM. *Brain and Cognition,* **4**, 477-485.

Ellingson, R.J. & Peters, J.F. (1980). Development of EEG and daytime sleep patterns in normal full-term infants during the first 3 months of life: longitudinal observations. *Electroencephalography and Clinical Neurophysiology,* **49**, 112-117.

Ephron, H.S. & Carrington, P. (1966). Rapid eye movement sleep and cortical homeostasis. *Psychological Review,* **73**, 500-526.

Evans, C.R. & Newman, E.A. (1964). Dreaming: An analogy from computers. *New Scientist,* **419**, 577-579.

Fenwick, P., Schatzman, M., Worsley, A., Adams, J., Stone, S. & Baker, A. (1984). Lucid dreaming: Correspondence between dreamed and actual events in one subject during REM sleep. *Biological Psychology,* **18**, 243-252.

Ferguson, J. & Dement, W. (1968). Changes in intensity of REM sleep with deprivation. *Psychophysiology,* **4**, 380-381.

Ferguson, J., Henriksen, S., McGarr, K., Belenky, G., Mitchell, G., Gonda, W., Cohen, H. & Dement, W. (1968). Phasic event deprivation in the cat. *Psychophysiology,* **5**, 238-239.

Fisher, C. & Dement, W.C. (1963). Studies on the psychopathology of sleep and dreams. *American Journal of Psychiatry,* **119**, 1160-1168.

Foulkes, D. (1962). Dream reports from different stages of sleep. *Journal of Abnormal Social Psychology,* **65**, 14-28.

Foulkes, D. (1966). *The psychology of sleep.* New York: Scribner's.

Foulkes, D. (1973). What do we know about dreams and how did we learn it? Paper presented at the meeting of the Association for the

Psychophysiological Study of Sleep, San Diego, May, 1973.

Foulkes, D. (1982). A cognitive-psychological model of REM dream production. *Sleep*, **5**, 169.

Foulkes, D. (1986). A cognitive psychological model of REM dream production. *Sleep*, **5**, 2, 169-187.

Foulkes, D. & Rechtschaffen, A. (1964). Presleep determinants of dream content : Effects of two films. *Perceptual and Motor Skills*, **19**, 983-1005.

Foulkes, D. & Vogel, G. (1965). Mental activity at sleep onset. *Journal of Abnormal Psychology*, **70**, 231-243.

Foulkes, D. & Pope, R. (1973). Primary visual experience and secondary cognitive elaboration in stage REM: A modest confirmation and an extension. *Perceptual and Motor Skills*, **37**, 107-118.

Freemon, F.R. (1972). A well-written and comprehensive textbook on the process of sleep. Springfield Ill : cc. Thomas. Sleep Research: A critical review.

Freud, S. (1952/1901). *On Dreams*. New York: Norton.

Freud, S. (1965). *The interpretation of dreams*. New York: Avon Books (Originally published : 1900).

Gould, J.B. (1983). SIDS-a sleep hypothesis. In Tildon, J.T., Roeder, L.M. & Steinschneider, A. (Eds.) *Sudden Infant Death Syndrome*. New York: Academic Press.

Gray, J.A. (1982). *The Neuropsychology of Anxiety: An Enquiring into the Functions of the Septo-Hippocampal System*. New York: Oxford University Press,

Green, R.T. (1956). Surprise as a factor in the Von Restorff effect. *Journal of Experimental Psychology,* **52,** 340-344.

Greenberg, M.S. & Farah, M.J. (1986). The laterality of dreaming. *Brain and Cognition,* **5,** 307-321.

Gresham,S.C., Webb,W.B. & Williams, R.L.(1963). Alcohol and caffeine : Effects on inferred visual dreaming. *Science,* **140,** 1226-1227.

Grosser, G.S. & Siegal, A.W. (1971). Emergence of a tonic-phasic model for sleep and dreaming. *Psychological Bulletin,* **75,** 60-72.

Grossman, W., Gardener, R., Roffwarg, H., Fekete, A., Beers, L. & Weiner, H. (1971). Relations of dreamed to actual limb movement. Paper presented at the meeting of the Association for the Psychological Study of sleep. Bruges, Belgium, June 1971.

Hobson, J.A. (1988). *The Dreaming Brain.* New York: Basic Books.

Hobson, J.A., Goldfrank, F. & Snyder, F. (1965). Respiration and mental activity in sleep. *Journal of Psychiatric Research,* **3,** 79-90.

Hobson, J. & McCarley, R. (1971). *Neuronal activity in sleep: An annotated bibliography.* Los Angeles Brain Information Service.

Hobson, J.A. & McCarley, R.W. (1977). The brain as a dream state generator: An activation-synthesis hypothesis of the dream process. *The American Journal of Psychiatry,* **134,** (12) 1335-1348.

Horne, J. (1988). *Why we sleep: The functions of sleep in humans and other mammals.* New York: Oxford University Press.

Jouvet, M. & Delorme, J. (1965). Locus coeruleus et sommeil paradoxal. *Comptes Rendus des Seances de la Societe de Biologie,* **159,** 898-899.

Jung, C. G. (1960/1961). General aspects of dream psychology. In *The collected works of C.G. Jung*, **8**, 237-280.

Kleitman, N. (1963). *Sleep and Wakefulness*. Chicago: University of Chicago.

Klinger, E. (1971). *Structure and Functions of Fantasy*. New York: Wiley-Interscience.

Kosslyn, S.M. & Pomerantz, J.R. (1977). Imagery, propositions and the form of internal representation. *Cognitive Psychology*, **9**, 52-76.

Kramer, M., McQuarrie, E. & Bonnet, M. (1982). Dream differences as a function of REM period position. *Sleep Research*, **11**, 122.

Kramer, M., Czaya, J., Arand, D. & Roth, T. (1974). The development of psychological content across the REM period. *Sleep Research*, **3**, 121.

LaBerge, S.P. (1985). *Lucid dreaming*. Los Angeles: Jeremy P. Tarcher.

LaBerge, S.P., Nagel, L.E., Dement, W.C. & Zarcone, V.P., Jr. (1981). Lucid dreaming verified by volitional communication during REM sleep. *Perceptual and Motor Skills*, **52**, 727-732.

Lazarus, R. (1984). On the primacy of cognition. *American Psychologist*, **39**, (2) 117-123.

McCarley, R. (1983). REM dreams, REM sleep and their isomorphisms. In Chase, M.H. & Weitzman, E.D. (Eds.) Sleep Disorders: Basic and Clinical Research. *Advances in Sleep Research*, **8**, (23) 335-346. Spectrum Publications, Inc.

McCarley, R.W. & Hoffman, E. (1981). REM sleep dreams and the activation-synthesis hypothesis. *American Journal of Psychiatry*, **138**, 904-912.

McGinty, D.J. & Sterman, M.B. (1980). Sleep physiology, Hypoxemia and Sids. *Sleep*, **3**, 314.

McGuigan, F.J. & Tanner, R. G. (1970). Covert oral behaviour during conversational and visual dreams. *Psychophysiology*, **7**, 329.

Meier, C., Ruef, H., Ziegler, A. & Hall, C. (1968). Forgetting dreams in the laboratory. *Perceptual and Motor Skills*, **26**, 551-557.

Meyers, M.B. & Smith, B.D. (1987). Cerebral processing of nonverbal affective stimuli: Differential effects of cognitive and affective sets on hemisphere asymmetry. *Biological Psychology*, **24**, 67-84.

Molinari, S. & Foulkes, D. (1969). Tonic-phasic events during sleep : Psychological correlates and implications. *Perceptual and Motor Skills*, **29**, 343-368.

Monroe, L.J., Rechtschaffen, A., Foulkes, D. & Jensen, J. (1965). Discriminability of REM and NREM reports. *Journal of Personality and Social Psychology*, **2**, 456-460.

Morrison, A.R. & Pompeiano, O. (1970). Vestibular influences during sleep. VI. Vestibular control of autonomic functions during the rapid eye movements of desynchronized sleep. *Archives Italiennes de Biologie*, **108**, 154-180.

Moruzzi, G. (1963). Active processes in the brain stem during sleep. *Harvey Lecture Series*, **58**, 233-297.

Moruzzi, G. (1965). General discussion, in *Aspects anatomo-fontctionnels de la physiologie du sommeil. Actes du Colloque International sur les Aspects Anatomo-fonctionnels de la Physiologie du Sommeil, Lyon.* Colloques Internationaux du Centre National de la Recherche Scientifique, 127.

Offenkrantz, W. & Rechtschaffen, A. (1963). Clinical studies of sequential dreams : 1. a patient in psychotherapy. *Archives of General Psychiatry,* **8,** 497-508.

Othmer, E., Hayden, B.P. & Segelbaum, T. (1969). Encephalic cycles during sleep and wakefulness in humans: a 24-hour pattern. *Science,* **164,** 447-449.

Pessah, M. & Roffwarg, H (1972a). Middle ear muscle activity during sleep: An important new phasic phenomenon. *Psychophysiology,* **9,** 127-128.

Pessah, M.A. & Roffwarg, H.P. (1972b). Spontaneous middle ear muscle activity in man: A rapid eye movement phenomenon. *Science,* **178,** 773-776.

Piccione, P., Thomas, S., Roth, T. & Kramer, M. (1976). Incorporation of the laboratory situation in dreams. *Sleep Research,* **5,** 120.

Pivik, R.T. (1971). Mental activity and phasic events during sleep. (Doctoral dissertation, Stanford University) Ann Arbor, Michigan: University Microfilms, No. 71-19746.

Pivik, R.T. (1974). In Antrobus, J.S., Arkin, A.M. & Ellman, S.J. (Eds.) *The mind in sleep-Psychology, Physiology.* New York: John Wiley & Sons, Inc.

Pivik. J. & Foulkes, D. (1966). "Dream deprivation" : Effects on dream content. *Science,* **153,** 1282-1284.

Pivik, T. & Foulkes, D. (1968). NREM mentation: Relation to personality, orientation time, and time of night. *Journal of Consulting and Clinical Psychology,* **37,** 144-151.

Pivik, T., Halper, C. & Dement, W. (1969). Phasic events and mentation during sleep. *Psychophysiology,* **6,** 215.

Rechtschaffen, A. (1973). The psychophysiology of mental activity during sleep. In McGuigan F.J. & Schoonover R.A. (Eds.) *The psychophysiology of thinking*. New York: Academic Press.

Rechtschaffen, A. & Kales, A. (Eds.) (1968). A Manual of Standardized Terminology, Techniques and Scoring System for Sleep Stages of Human Subjects. *Washington D.C. U.S. Government Printing Office.*

Rechtschaffen, A., Mollinari, S., Watson, R. & Wincor, M. (1970). Extraocular potentials: A possible indicator of PHGO activity in the human. Paper presented at the Association for the Psychophysiological study of sleep, Santa Fe, New Mexico, 1970. *Psychophysiology,* **1**, 336.

Rechtschaffen, A., Watson, R., Wincor, M., Molinari, S. & Barta, S. (1972). The relationship of phasic and tonic periorbital EMG activity to NREM mentation. *Sleep Research,* **1**, 114.

Rechtschaffen, A. & Buchigiani, C. (1983). Visual dimensions and correlates of dream images. *Sleep Research,* **12**, 189.

Roffwarg, H., Dement, W., Muzio, J. & Fisher, C. (1962). Dream imagery: Relationship to rapid eye movements of sleep. *Archives of General Psychiatry,* **7**, 235-258.

Roffwarg, H., Adrien, J., Herman, J., Lamstein, S., Pessah, M., Spiro, R. & Bowe-Anders, C. (1973). The place of the middle ear muscle activity in the neurophysiology and psychophysiology of the REM state. *Sleep Research,* **2**, 36.

Salamy, J. (1970). Instrumental responding to internal cues associated with REM sleep. *Psychonomic Science,* **18**, 342-343.

Seligman, M. & Yellen, A. (1987). What is a dream. *Behaviour Research and Therapy,* **25**, 1-24.

Siegel, J.M., Nienhuis, R., Wheeler, R.L., McGinty, D.J. & Harper, R.M. (1981). Discharge patterns of reticular formation unit pairs in waking and REM sleep. *Experimental Neurology,* **74,** 875-981.

Snyder, F. (1965). The organismic state associated with dreaming. In Greenfield, N. (Ed.) *Psychoanalysis and Current Biological Thought.* Madison: University of Wisconsin Press.

Snyder, F. (1966). Toward and evolutionary theory of dreaming. *American Journal of Psychiatry,* **123,** 121-142.

Snyder, F. (1970). The phenomenology of dreaming. In Madow H. & Snow L.H. (Eds.) *The psychodynamic implications of the physiological studies on dreams.* Springfield, Illinois: Charles C. Thomas.

Sterman, M.B. (1967). Relationship of intrauterine fetal activity to maternal sleep stage. *Experimental Neurology (Supplement),* **4,** 98-106.

Tucker, D.M. (1981). Lateral brain function, emotion and conceptualization. *Psychological Bulletin,* **89,** 19-46.

van den Hout, M.A., Zijlstra, B.C. & Merckelbach, H. (1989). Case histories and shorter communications. Selective recall of surprising visual scenes. An experimental note on Seligman and Yellen's theory of dreams. *Behaviour Research and Therapy,* **27,** (2) 199-201.

Van De Castle, R.L. (1973). The psychology of dreaming. In Lee, S. & Mayes, A. (Eds.) *Dreams and dreaming.* Middlesex, England: Penguin.

Verdone, P. (1965). Temporal reference of manifest dream content. *Perceptual and Motor Skills,* **20,** 1253-1268.

Von Restorff, H. (1933). Ueber die wirkung von Bereichsbildungen im Spurenfeld. *Psychologischer Forschungen,* **18,** 299-342.

Vogel, G.W. (1978). An alternative view of the neurobiology of dreaming. *American Journal of Psychiatry,* **135,** 1531-1535.

Vogel, G.W, Foulkes, D. & Trosman, H. (1966). Ego functions and dreaming during sleep onset. *Archives of General Psychiatry,* **14,** 238-248.

Watson, R. (1972). Mental correlates of periorbital PIPs during REM sleep. *Sleep Research,* **1,** 116.

Watson, R., Bliwise, D., Friedman, L., Wax, D. & Rechtschaffen, A. (1978). Phasic EMG in human sleep: II Periorbital potentials and REM mentation. *Sleep Research,* **7,** 57.

Wells, D.T., Allan, R.P. & Wagman, A.M.I. (1977). A Single-channel system of recording eye movements. *Psychophysiology,* **14,** 73-74.

Weisz, R. & Foulkes, D. (1970). Home and laboratory dreams collected under uniform sampling conditions. *Psychophysiology,* **6,** 588-596.

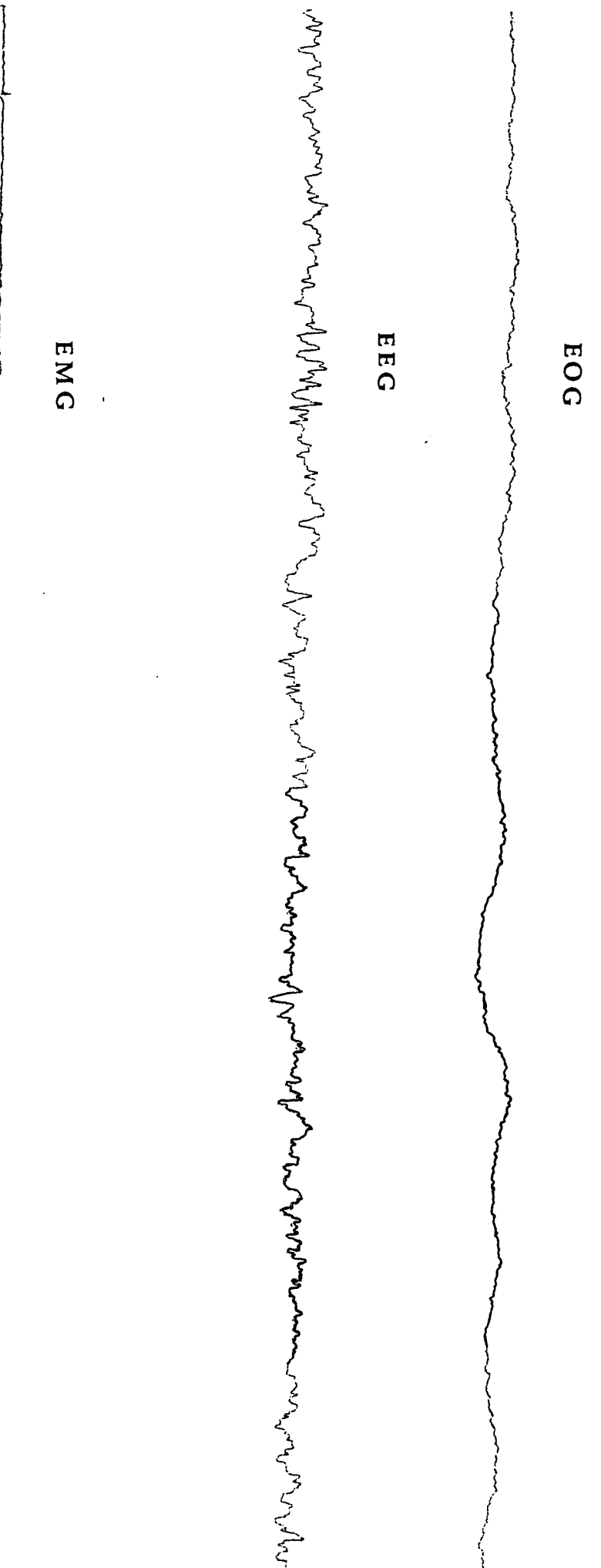
Wolpert, E. (1960). Studies in psychophysiology of dreams. II. An electromyographic study of dreaming. *Archives of General Psychiatry,* **2,** 231-241.

Zajonc, R.B. (1984). On the primacy of affect. *American Psychologist,* **39,** 2, 117-123.

APPENDICES

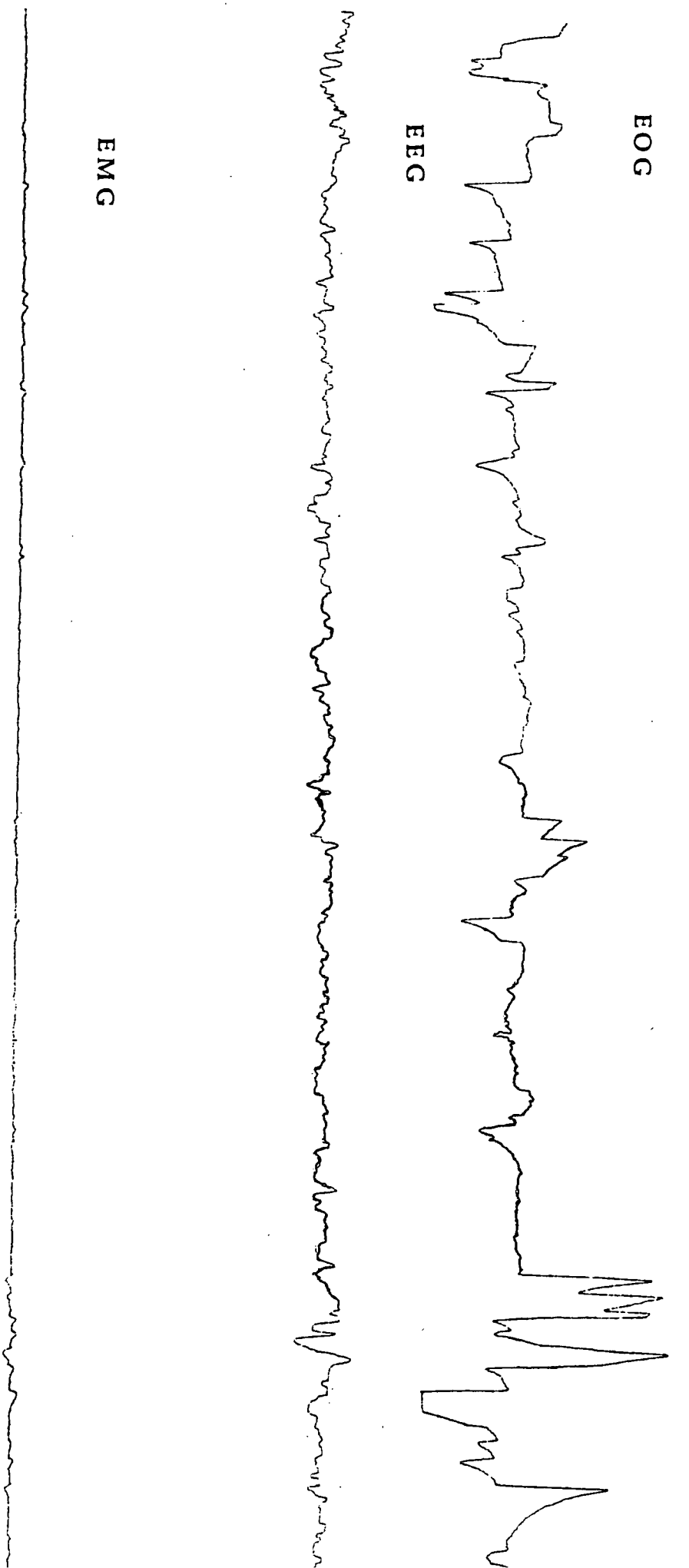
APPENDIX A

Tonic-REM Polygraph Tracing



APPENDIX B

Phasic-REM Polygraph Tracing



APPENDIX C

INSTRUCTIONS TO RATES - SCALE OF SURPRISINGNESS

DREAMS VARY A GREAT DEAL IN THE EXTENT TO WHICH THE SEQUENCES OF IDEAS AND IMAGERY FORMS A SINGLE COHERENT NARRATIVE. GENERALLY THERE IS SOME RECOGNIZABLE THEME OR PLOT TO THE STORY TO WHICH SUBSEQUENT IMAGES ARE RELATED, BUT THERE CAN ALSO BE SOME SURPRISING AND UNRELATED IMAGES.

THE TASK AT HAND IS TO RATE THE PHRASE WHICH HAS BEEN ITALICIZED FOR SURPRISINGNESS OR UNSURPRISINGNESS IN RELATION TO THE PROCEEDING PLOT.

USING THIS SCALE RATE EACH DREAM REPORT BY GIVING IT A PARTICULAR NUMBER:

1 = VERY SURPRISING

2 = MODERATELY SURPRISING

3 = SOMEWHAT SURPRISING

4 = MODERATELY UNSURPRISING

5 = VERY UNSURPRISING

APPENDIX D

I was dreaming about living with L. last year. It was really good fun but we were both extremely busy.
I was then ironing a white curtain but it turned out to be a dress.
It was then really nice weather and L. and I were driving along the east coast and we were both sitting in the back seat of the car. "What if you needed to stop ?", I said.
We were then on our way to the chemist for my cold.

G. (my boyfriend) was dressed up as a woman and was walking along the wharf. When he saw me he threw a big bunch of white and yellow flowers into the water.

I was dreaming about living with L. last year. It was really good fun but we were both extremely busy.
I was then ironing a white curtain but it turned out to be a dress.
It was then really nice weather and L. and I were driving along the east coast and we were both sitting in the back seat of the car. "What if you needed to stop ?", I said.
We were then on our way to the chemist for my cold.

There were school girls making cups of porcelain to put together to make a love heart. They had roses on them.

Teenage girls at school in the toilets. I was in the toilets talking to a girl and she wanted me to leave so she could have a smoke.
Then I was in Glenorchy and we were riding horses around a small paddock. It was not particularly enjoyable. I was talking to M. G. and he was telling me about his life which is very unusual for him.

There were school girls making cups of porcelain to put together to make a love heart. They had roses on them.

Teenage girls at school in the toilets. I was in the toilets talking to a girl and she wanted me to leave so she could have a smoke.
Then I was in Glenorchy and we were riding horses around a small paddock. It was not particularly enjoyable. I was talking to M. G. and he was telling me about his life which is very unusual for him.

G. (my boyfriend) was dressed up as a woman and was walking along the wharf. When he saw me he threw a big bunch of white and yellow flowers into the water.

I was thinking that some people make some very silly mistakes. I was at home, I decided to invite M. to tea whom I hadn't seen since 1985. I was thinking about my friend J. and I didn't invite M. to tea. I went for a walk and I was in Sydney.

There was this bloke who was wearing these disgusting blue trousers.

I was thinking that some people make some very silly mistakes. I was at home, I decided to invite M. to tea whom I hadn't seen since 1985. I was thinking about my friend J. and I didn't invite M. to tea. I went for a walk and I was in Sydney.

We were talking about trucks and the vehicle turned into a log truck.

I was dreaming about being here and I suddenly woke up to being at my parents place except that my parents place was at the University.
I was getting irritated at my brother who kept snapping at mum and then he went off to look at some photos. Dad was teaching me to play this old card game.
My mother and I walked down this pathway near the Arts Lecture Theatre at the University. She said, "Oh! you went to bed very late last night."
I was dreaming about dreams and I was with you and we were in this vehicle.

We were talking about trucks and the vehicle turned into a log truck.

I was dreaming about being here and I suddenly woke up to being at my parents place except that my parents place was at the University.
I was getting irritated at my brother who kept snapping at mum and then he went off to look at some photos. Dad was teaching me to play this old card game.
My mother and I walked down this pathway near the Arts Lecture Theatre at the University. She said, "Oh! you went to bed very late last night."
I was dreaming about dreams and I was with you and we were in this vehicle.

There was this bloke who was wearing these disgusting blue trousers.

It was about going to an ear specialist for an ear ache. He was saying to me that he's interested in everyone's ears. He was also talking about his interest in cars. He said that its usually the old ones that have problems. I was talking to the Specialist at the Royal Hobart Hospital. The room was strange. He then checked my veins and found no problem.

The doctor's face was very clear.

It was about going to an ear specialist for an ear ache. He was saying to me that he's interested in everyone's ears. He was also talking about his interest in cars. He said that its usually the old ones that have problems. I was talking to the Specialist at the Royal Hobart Hospital. The room was strange. He then checked my veins and found no problem.

There was this booklet.

I was with the people in my class in a small room of the school canteen, I can't remember exactly, and my good friend from school was with me. I just played a joke on him by saying that the guy in the reflection was really stupid. Then this girl suddenly got really upset with me and started to form an organization with membership available.

There was this booklet.

I was with the people in my class in a small room of the school canteen, I can't remember exactly, and my good friend from school was with me. I just played a joke on him by saying that the guy in the reflection was really stupid. Then this girl suddenly got really upset with me and started to form an organization with membership available.

The doctor's face was very clear.

I was dreaming that I was absolutely dying to go to the toilet.

I was banging on the bed and on the door and screaming out your name.

I was dreaming that I was absolutely dying to go to the toilet.

Four of the women started playing strange musical instruments.

I was at a beach with T. (a friend of mine). T. turned into another friend of mine, R. The beach became a Chinese festival. There were about 10 women monks sitting crosslegged in a circle as wide as Stone Henge.

Four of the women started playing strange musical instruments.

I was at a beach with T. (a friend of mine). T. turned into another friend of mine, R. The beach became a Chinese festival. There were about 10 women monks sitting crosslegged in a circle as wide as Stone Henge.

I was banging on the bed and on the door and screaming out your name.

I was dreaming that I wanted a Devonshire tea and you (the experimenter) had come in here and unplug me. Then I had to go to see my aunt. I was suddenly in a pinball arcade and H. (my friend) was watching T.V. When I walked in I still had all the wires attached to my head and I felt really embarrassed.
Then there was a man delivering a package for the girl next door but there was no one at home. He wanted me to sign for the package and I said alright. He took out his paper and I had to sign it.

He took out these tweezers.

I was dreaming that I wanted a Devonshire tea and you (the experimenter) had come in here and unplug me. Then I had to go to see my aunt. I was suddenly in a pinball arcade and H. (my friend) was watching T.V. When I walked in I still had all the wires attached to my head and I felt really embarrassed.
Then there was a man delivering a package for the girl next door but there was no one at home. He wanted me to sign for the package and I said alright. He took out his paper and I had to sign it.

A group of us went out to play footy.

I was dreaming that you came in to ask me about my dreams and that you told me off for not telling you that I had had a nightmare. You said that it had totally stuffed-up all your previous data for your other subject too.
Then I was thinking that I must have borrowed somebody's pyjamas because I had my nightie on and these pyjamas over it, and that I was feeling very hot in bed.

A group of us went out to play footy.

I was dreaming that you came in to ask me about my dreams and that you told me off for not telling you that I had had a nightmare. You said that it had totally stuffed-up all your previous data for your other subject too.
Then I was thinking that I must have borrowed somebody's pyjamas because I had my nightie on and these pyjamas over it, and that I was feeling very hot in bed.

He took out these tweezers.

There were a lot of weird things happening before you woke me up. There were images about my family in Melbourne. One of them was very ill. We were going to the hospital.

There was a lady and she was being carried in by someone.

There were a lot of weird things happening before you woke me up. There were images about my family in Melbourne. One of them was very ill. We were going to the hospital.

Then we were doing the dishes in the kitchen.

There was a lady we knew who was running a business. She had had a house designed to run the business.

Then we were doing the dishes in the kitchen.

There was a lady we knew who was running a business. She had had a house designed to run the business.

There was a lady and she was being carried in by someone.

I was dreaming that I was in this experiment and I was dreaming that I could not get to sleep. We were then on the oval at the University and I was with S. (my friend) and mum.

There was this dog there and the dog was following this old man.

I was dreaming that I was in this experiment and I was dreaming that I could not get to sleep. We were then on the oval at the University and I was with S. (my friend) and mum.

People were using words which told me about the experiment.

I was doing some kind of experiment like this. I did not understand what I was supposed to be doing. I went back to another room.

People were using words which told me about the experiment.

I was doing some kind of experiment like this. I did not understand what I was supposed to be doing. I went back to another room.

There was this dog there and the dog was following this old man.

APPENDIX E

INSTRUCTIONS TO RATERS

This analysis investigates the extent to which dreams incorporate the events and thoughts of the previous day.

You are presented with two diary descriptions of the days events and thoughts.

Attached to these diary descriptions are three dream reports.

Using the first diary description please rate the extent to which each of the three dream reports incorporates the events and thoughts reported in the diary description.

If most or all of the dream report refers directly to these events or thoughts it will receive a rating of 4. If there is no indication of the diary events or thoughts in the dream, the report will receive a rating of 0. Where about half or more of the dream report refers to events or thoughts in the diary. it will receive a rating of 2 or 3.

Repeat this procedure for diary description 2.

Repeat this procedure for the two sequences of dream imagery highlighted in pink and blue.

* Rate on the basis of direct incorporation only, not intuition.

Rate each subjects' dreams individually.

N.B. Events like coming to the sleep laboratory and writing day's diary should be regarded as universally present in the diary descriptions even if they are not mentioned.

It is expected that confidentiality will be observed since this is the personal property of each individual subject.

RATING SHEET

SCALE:

0 = No indication of diary events or thoughts in dream report or imagery (0%)
1= Some indication of diary events or thoughts in dream report or imagery (25%)
2 = Half of the dream report or imagery refers to diary events (50%)
3 = More than half of the dream report or imagery refers to diary events (75%)
4 = Most or all of the dream report or imagery refers directly to diary events (100%)

Subjects and diaries	Incorporation of dream report	Incorp. imagery highlighted pink	Incorp. imagery highlighted blue
Diary 1 1a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 1b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 2a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 2b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 3a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 3b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 4a)	1: 2: 3:	1: 2: 3:	1: 2: 3:

RATING SHEET

SCALE:

0 = No indication of diary events or thoughts in dream report or imagery (0%)
1= Some indication of diary events or thoughts in dream report or imagery (25%)
2 = Half of the dream report or imagery refers to diary events (50%)
3 = More than half of the dream report or imagery refers to diary events (75%)
4 = Most or all of the dream report or imagery refers directly to diary events (100%)

Subjects and diaries	Incorporation of dream report	Incorp. of imagery highlighted pink	Incorp. of imagery highlighted blue
Diary 2 4b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 5a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 5b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 6a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 6b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 7a)	1: 2: 3:	1: 2: 3:	1: 2: 3:

RATING SHEET

SCALE:

0 = No indication of diary events or thoughts in dream report or imagery (0%)
1= Some indication of diary events or thoughts in dream report or imagery (25%)
2 = Half of the dream report or imagery refers to diary events (50%)
3 = More than half of the dream report or imagery refers to diary events (75%)
4 = Most or all of the dream report or imagery refers directly to diary events (100%)

Subjects and diaries	Incorporation of dream report	Incorp. of imagery highlighted pink	Incorp. of imagery highlighted blue
Diary 2 7b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 8a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 8b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 9a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 9b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 10a)	1: 2: 3:	1: 2: 3:	1: 2: 3:

RATING SHEET

SCALE:

0 = No indication of diary events or thoughts in dream report or imagery (0%)
1= Some indication of diary events or thoughts in dream report or imagery (25%)
2 = Half of the dream report or imagery refers to diary events (50%)
3 = More than half of the dream report or imagery refers to diary events (75%)
4 = Most or all of the dream report or imagery refers directly to diary events (100%)

Subjects and diaries	Incorporation of dream report	Incorp. of imagery highlighted pink	Incorp. of imagery highlighted blue
Diary 2 10b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 11a)	1: 2: 3:	1: 2: 3:	1: 2; 3:
Diary 2 11b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 12a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 12b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 13a)	1: 2: 3:	1: 2: 3:	1: 2: 3:

RATING SHEET

SCALE:

0 = No indication of diary events or thoughts in dream report or imagery (0%)
1= Some indication of diary events or thoughts in dream report or imagery (25%)
2 = Half of the dream report or imagery refers to diary events (50%)
3 = More than half of the dream report or imagery refers to diary events (75%)
4 = Most or all of the dream report or imagery refers directly to diary events (100%)

Subjects and diaries	Incorporation of dream report	Incorp. of imagery highlighted pink	Incorp. of imagery highlighted blue
Diary 2 13b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 14a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 14b)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 1 15a)	1: 2: 3:	1: 2: 3:	1: 2: 3:
Diary 2 15b)	1: 2: 3:	1: 2: 3:	1: 2: 3:

APPENDIX F

Inter-Rater Reliability for Hypothesis 2(a)

Correlation Matrix for Variables: X_1 ... X_4

	Rater 1.1	Rater 2.1	Rater 3.1	Rater 4.1
Rater 1.1	1			
Rater 2.1	.298	1		
Rater 3.1	.366	.575	1	
Rater 4.1	.496	.609	.525	1

Inter-Rater Reliability for Hypothesis 2(b)

Correlation Matrix for Variables: X_1 ... X_4

	Rater 1.2	Rater 2.2	Rater 3.2	Rater 4.2
Rater 1.2	1			
Rater 2.2	.752	1		
Rater 3.2	.598	.529	1	
Rater 4.2	.739	.779	.466	1

Inter-Rater Reliability for Hypothesis 3(a)

Correlation Matrix for Variables: X_1 ... X_3

	RATER 1	RATER 2	RATER 3
RATER 1	1		
RATER 2	.459	1	
RATER 3	.408	.403	1

Inter-Rater Reliability for Stripped Vivid Images

Correlation Matrix for Variables: X_1 ... X_3

	Rater 1	Rater 2	Rater 3
Rater 1	1		
Rater 2	.773	1	
Rater 3	.782	.645	1