

THE EFFECTS OF INTENSIVE LEARNING OF A  
SECOND LANGUAGE ON REM SLEEP  
AND DREAM CONTENT

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## CURRICULUM STUDIORUM

Guy-Bernard Proulx was born August 28, 1951, in Ottawa, Ontario. He received the Bachelor of Psychology degree from the University of Ottawa, Ottawa, Ontario, in 1974.

## ABSTRACT

### The Effects of Intensive Learning of a Second Language on REM Sleep and Dream Content

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At the University of Ottawa a six week total immersion course in French is given during which students live on campus and are required to speak French all day. Their activities including meals, social events and so forth are supervised to ensure they do not speak English. It was thought that this situation of intense learning would permit one to test the hypothesis that REM sleep is involved in the processing of new information. An increase in REM sleep activity as well as alterations in dream content were therefore expected in this new learning situation.

Four English speaking students slept in the laboratory for three series of six consecutive nights (two adaptation nights, two nights of uninterrupted sleep, and two nights of dream collection). One series was before the course, a second during the course and a third after the course. On the first four uninterrupted nights of each series, subjects slept between seven and eight hours (according to their individual sleep habits) and there was no significant change in total sleeping time across the series. The last two nights of each series were for dream collection purposes.

Since it was felt that participation in the course could produce a fair amount of stress and thus affect sleep patterns perhaps reducing REM sleep, subjects were asked to rate on a 1-10 scale how much stress they experienced during each of the three monitoring periods. In addition, scores were obtained on the progress made in French, as measured by pre- and post-course tests.

Two subjects had a substantial increase in REM percent during the course, one had a decrease, and one had essentially no change. These results do not appear to support the postulated increase in REM sleep with (second language) learning. It is of interest however to note that the two subjects who had an increase in REM sleep did not report increases in stress during the course period and made reasonable progress in French, whereas the reverse was true for the other subjects. It is possible that the fluctuations observed in REM percent reflect learning efficiency, stress, or both.

During the course period, there was a general tendency for dreams to incorporate more verbal communication elements as well as a greater amount of cognitive activity. Here again, it was interesting to note the consistency in the differences between subjects who made progress in French and those that did not.

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## CHAPTER I

### Introduction

The traditional view of sleep as the antithesis of wakefulness was popular until the discovery by Aserinsky and Kleitman (1953), that sleep is characterized by two cyclically recurring phases. One phase, termed rapid eye movement (REM) sleep, is accompanied by binocularly conjugate rapid eye movements; while in the other phase, termed non-rapid eye movement (NREM) sleep, the eyes are either immobile or exhibit slow rolling movements. Moreover, neurophysiological studies have shown central nervous system activity during the REM stage to be as great as during the wakefulness state (Hobson, 1972). The REM state is now considered a third active phase qualitatively different from wakefulness and NREM sleep.

An interesting finding related to this two-stage sleep phenomenon was the suggestion, by its discoverers, that REM sleep was the physiological correlate of dreaming. A study by Dement and Kleitman (1957) added support to this contention. They found that people awakened from the REM state reported dreaming much more often than when they were awakened from NREM sleep.

The techniques and discoveries of Aserinsky, Kleitman and Dement have greatly stimulated sleep and dream research. Prior to their work, not many psychologists seemed interested in sleep and dreams because dreaming was commonly considered to be an

unreal, subjective experience not observable by anyone else except the dreamer himself, and not testable by scientific methods. Today, however, it is thought that if sleep, dreams and EEG tracings are somehow related, then the still mystical nature of sleep and dreams can be investigated in an experimental laboratory. In fact, many sleep researchers ultimately aim to measure physiological events concomitant to the subjective experience of dreams in the hope of uncovering new, counter-intuitive phenomena. This would bring us closer to more fully understanding the underlying nature of sleep behaviour.

A major problem of the psycho-physiological approach to sleep research is the fact that studies have indicated that dreaming is not limited to REM sleep (except that REM awakenings produce more dream reports). It is now suggested that some form of thinking or dreaming processes do occur in NREM sleep also (Foulkes, 1962). This "REM-dreaming" controversy is in itself a major question with which most sleep researchers struggle. It is a basic problem that cannot, at present, be nicely separated while we deal with each in turn. Despite these controversies, there has been a proliferation of studies during the last decade on the functions of REM sleep and dreaming.

Many authors have proposed that during the REM state, daily information is integrated physiologically and

psychologically. One of the most appealing hypothesis along these lines is Dewan's "P" hypothesis (1970). He suggests that REM sleep is related to a process of setting up functional structures or programs in the brain. According to him, the brain of higher animals is in a state of constant alteration in the sense that its functional structures are constantly being revised for current situations and needs. Dewan furthermore predicts that under intense conditions of learning there should be a greater need for reprogramming and this would manifest itself through an increase of REM activity. Similarly, many investigators approach the dream as essentially continuous with waking behaviour (for example, Hauri, 1967; Pearlman, 1970; Rossi, 1972). However, while specifics of the theories vary, each in its own way attributes to the dream the function of facilitating some aspect of the dreamer's mastery over his environment.

An example of a situation where a person has to adapt and assimilate a great deal of new information is that of English students immersed in the French Summer School of the University of Ottawa. According to the notion that REM sleep plays an active role in learning (Breger, 1967; Dewan, 1970; Hartmann, 1973; Moruzzi, 1966), an increased demand for REM sleep as well as dream content alterations should be expected to follow

intense learning of a second language. The present study examined this problem by asking a group of four students to sleep in the laboratory where their sleep cycle and dreams were monitored before, during and after a French immersion course.

Throughout the following pages this dissertation will, in its review of the literature, provide a brief description of the electrophysiological characteristics of sleep, consider the major theories on the functions of REM sleep and emphasize the literature which maintains that during REM sleep the brain carries out active processes related to cognitive activities, namely learning. Chapter III will then describe in detail the study conducted by the writer on the effects of intensive learning of a second language on REM sleep and dream content. Finally, Chapter IV will focus on the presentation and discussion of the results.

## CHAPTER II

### Review of the Literature

#### Electrophysiological Characteristics of Sleep

Sleep onset in the adult mammal usually begins with non-rapid eye movement (NREM) sleep and is followed by the cyclical recurrence of periods of rapid eye movement (REM) sleep (Dement & Kleitman, 1957). During NREM sleep the electroencephalogram (EEG) shows synchronized, high voltage slow waves together with some faster spindling activity. Generally, research indicates that NREM sleep is essentially a state of central nervous system quiescence and regularity. Thus, blood pressure, respiration, and heart rate show lower values and little temporal variability. A relatively low body temperature, high basal skin resistance, and low urinary output are other physiological indices which differentiate NREM sleep from wakefulness and REM sleep. The EEG is arbitrarily used to divide the NREM continuum into four stages of sleep. Stage 1 is characterized by low voltage, mixed frequency EEG with a prominence of activity in the 4-7 Hz range (theta activity) and a loss of waking 8-13 Hz alpha rhythms; stage 2 is defined by the presence of 12-15 Hz sleep spindles and/or K complexes and less than 20% of high voltage (over 75 microvolt) delta activity of 3 or less Hz frequency; stage 3 consists of at least 20% but not more than 50% of delta activity; and stage 4 consists of 50-100% such delta activity (Rechtschaffen & Kales, 1968).

The onset of each REM period is marked by striking changes in physiological events. The EEG is desynchronized; that is, relatively low voltage mixed frequencies and occasional superimposed "saw-toothed waves" are observed. There is an increase in the rate and irregularity of heartbeat and respiration as well as the presence of penile erections in males and increased vaginal blood flow in females. Also characteristic of REM sleep is the absence of tone in the midline axial muscles of the body, usually monitored by a submental electromyogram (EMG). Motor phenomena including twitching movements of the extremities and facial regions and bursts of rapid eye movements are other salient features of REM sleep.

In the normal young adult, stage 1 represents about 5% of total sleep time; stage 2, 50-55%; stage 3, 10%; stage 4, 10% and REM sleep, 20-25%. Furthermore, NREM sleep tends to become less as the night progresses in length from the second to the third cycle and then stabilize such that the last third of sleep is about 50% in REM and 50% in NREM sleep.

### Psychophysiological Functions of REM Sleep

What purpose is served by the universal occurrence of REM sleep and how could a theory be "useful" in understanding its functions? Since the early boom of the mid-sixties in sleep research, over 60 scientific articles are now published each month in this field. It seems apparent that the development of sleep research has reached the point where some type of general theory is needed to

hold together the disparate findings. Sleep researchers generally agree that REM sleep probably has many functions and that, at present, no one theory provides a complete description of why REM sleep occurs. Hence, a review of the most important theories on the functions of REM sleep would seem appropriate at this point.

a) Ontogenetic development of the human sleep-dream cycle.

Roffwarg, Muzio and Dement (1966) have suggested that the prime role of "dreaming sleep" in early life may be in the ontogenetic development of the central nervous system. Citing evidence showing that REM sleep assumes a high proportion of total sleep in the first days of life and that its amount and ratio to total sleep diminish as maturation proceeds, Roffwarg and his co-workers thus suggest that the endogenous stimulation of the REM state functions to assist the maturation and differentiation of the CNS in utero and during infancy when external stimulation is minimal.

The consistency of this developmental sleep pattern in all mammals studied so far suggest that REM sleep does in fact serve some important developmental function (Feinberg, 1974). However, this theory leaves unexplained certain phylogenetic data. How can we explain, for example, the fact that at birth, rats and

cats have higher percentages of REM than man who is more immature at birth? (Allison & Van Twyver, 1970). Furthermore, Roffwarg's hypothesis stresses the importance of REM at the beginning of ontogenesis but we still have major methodological difficulties in quantifying sleep stages in new born children.

b) The oculomotor innervation hypothesis.

Berger (1969), has proposed that REM sleep provides a mechanism for the establishment of the neuromuscular pathways involved in voluntary conjugate eye movements in both phylogenesis and ontogenesis; and that throughout mammalian life REM sleep furnishes periodic innervation of the oculomotor system during extended periods of sleep, in order to maintain facilitation of binocularly coordinated eye movement into subsequent wakefulness.

This theory's major contribution was its attempt to account for the still intriguing role of the oculomotor system in "rapid eye movement" sleep. It does not, however, offer any explanation for the functional significance of high neuronal firing rates in various other parts of the brain during REM sleep. Furthermore, Allison and Van Twyver (1970) have reported finding no REM sleep in the primitive echidna, which has binocular vision.

c) Rem sleep and cortical homeostasis.

Along with Pavlov and others, a few theories suggest that NREM sleep has a difficult-to-specify function of pure rest or inactivity

for cortical neurons. They suggest that REM sleep functions to interrupt this state of quiescence. Thus Ephron and Carrington (1966) have suggested that NREM sleep is a kind of sensory deprivation which may be necessary (for unspecified reasons), but that long periods of such deprivation may be dangerous. They then suggest that REM sleep is a homeostatic mechanism whose role is to "reafferent" the cortex. Similarly, Weiss (1966) has proposed that REM sleep functions to reorganize central nervous system firing patterns which have become somehow disorganized during NREM sleep, while Hawkins (1966) has suggested that REM sleep serves to regularly reestablish patterned operation.

These "homeostatic" theories offer explanations for the persistence of REM sleep in the adult; the alternate cyclicity of the two types of sleep and the massive activation of the central nervous system. However, they cannot account for the rebound phenomena following REM deprivation. According to their theory, afferent activation during wakefulness should be able to compensate for REM deprivation.

Related to this is Snyder's hypothesis of the "arousal function" of REM sleep (1966). The author postulates that while extended sleep achieves conservation of energy, the REM state serves a "sentinel" function, bringing about brief but periodic awakenings after preparing the organism for immediate fight or flight. Such

a built-in physiological mechanism presumably would provide maximal security from external danger compatible with minimal disturbance to the continuity of sleep. These may have been unique and critical survival advantages in the early mammalian predicament. Thus, REM provides periodic cortical arousal so that the animal has sufficient "critical reactivity" to adequately "test" the environment for dangerous elements. This theory is consistent with the fact that in many species a brief arousal tends to follow each REM period. What is hardest to reconcile with the theory is that during REM sleep, despite the "aroused-looking" recordings from its cortex, the animal actually has a higher arousal threshold to external stimulation than during NREM sleep (Benoit & Bloch, 1960; Dillon & Webb, 1965).

d) REM sleep and information processing.

In recent years, a number of related theories have proposed that sleep has a role in dealing with memory and learning. The late sixties and early seventies have witnessed an increasing popularity of information processing models in Psychology. Thus, quite a few sleep researchers (Breger, 1967; Hartmann, 1973; Jouvet 1965; Moruzzi, 1966) have independently developed theories that view REM sleep as an active phenomenon involved in the processing of information. Generally speaking, all these theories imply that REM sleep is involved in a continuous cortico-structural organization and reorganization of new inputs.

The most ambitious and wide-scope of such theories is Dewan's Programming hypothesis of REM sleep, better known as the "P" hypothesis (Dewan, 1970). This theory's major appeal is that it attempts to integrate most of the ideas elaborated in the aforementioned theories. Based on these previous theories, Dewan points out that the most interesting observations about REM sleep are: 1) the phylogenetic development of REM which increases from zero percent in the lowest animals to about 25 percent of sleep for the mammals and 2) the ontogenetic development of REM which decreases from birth and childhood to adulthood and senility when - implies Dewan - learning and recall for new memories are at their lowest values. In the context of the above remarks, the most theoretically compelling observations according to Dewan are that REM sleep is associated with dreams and that the percentage of REM sleep rebounds after suppression, implying that it does something of importance to or for the organism. All this, therefore, led Dewan to hypothesize that REM sleep plays an important role in programming the brain.

By drawing an analogy between the brain and a computer, Dewan suggests that in the brain the functional structure or pathways can be altered; that the brain has a way of reprogramming itself spontaneously and automatically. He supposes that learning constitutes a temporary storage of programs and information and that

to consolidate, one must have REM sleep. He also suggests that only with REM does learning become integrated or consolidated. Consequently if REM sleep is related to consolidation of memory into the best configuration of the organism's needs, one should expect an increased demand for REM sleep following situations of increased learning. The following will examine studies testing this hypothesis.

#### REM Sleep and Learning: Research Evidence

Jenkins and Dallenbach (1924) were probably the first to report that memory for verbal materials was facilitated if subjects slept during the retention interval, as opposed to being awake. This observation was replicated by Ekstrand (1967). Since then, there is increasing empirical evidence in favor of a functional relation between the REM phase of sleep and learning.

Correlational and observational studies show that newborn animals and babies have a greater proportion of REM sleep with respect to total sleep time than do adults (Feinberg, 1974; Hartmann, 1970) and that there is a progressive decrease in that proportion as growing continues, which is paralleled by a decrease in learning ability. Mental disease in man is accompanied by alterations in REM sleep parameters whenever a learning disability exists. Aphasic patients, for example, show an increase in REM

sleep time in relation with their recovery (Greenberg & Dewan, 1969). Feinberg (1968) has found significant correlations between I.Q. scores, REM percent and REM density in mentally retarded as compared to normals. Patients with Korsakoff disease have memory problems and show abnormalities in REM sleep (Greenberg, Pearlman & Brooks, 1968).

Another approach to research which implies that REM sleep might have some functional relationship with information processing is that which relates sleep variability to personality differences in short and long sleepers. Very few studies of this nature have been done mainly because short sleepers (4 hours or less) are quite rare. However, research in this area (Hartmann, Baekeland, Zwillling & Hoy, 1971; Hartmann, Baekeland & Zwillling, 1972; Stuss, Healey & Broughton, 1975) reveals that differences in sleep duration between the groups varied with the duration of REM sleep, NREM sleep being of equal duration in short, average, and long sleepers. REM density was significantly higher in long sleepers than in short sleepers. Psychological tests and interviews indicated that the short sleepers were a rather homogeneous group. They were characterized by an ambitious and energetic personality and by an efficient and active way of life; they held rather conformist social and political ideas and had few complaints about their life. The long sleepers were a less homogeneous group, with many subjects exhibiting signs of mild or moderate neurosis (anxiety, depression, inhibition of aggressive and sexual drives). They were generally insecure about their

lives and careers, had a definite concern for social and political problems and, in some cases, showed an artistic and creative temperament. The authors interpret these results by assuming that the long sleepers (or worriers or non-conformists) may need more REM sleep for restoring their brain from the stress of preoccupations and tension and from the strain of creative and imaginative thinking. On the contrary, the short sleepers (or non-worriers or conformists) would not need as much REM sleep because of their tendency to shy away from problems and worries and to follow rigidly "pre-programmed" lines of thought and action. These results lead one to believe that future research dealing with functions of sleep should emphasize carefully controlled analysis of individual differences.

Following the idea that REM sleep plays a role in memory and learning, the literature is profuse with experiments that have studied REM sleep as an independent variable. These studies have been extensively reviewed (Greenberg & Pearlman, 1974; Hennevin & LeConte, 1971; Vogel, 1975) and the weight of evidence indicates that because of many confounding variables, the effects of REM sleep deprivation on retention and on new learning remain unclear. Most REM deprivation studies with animals use the "platform procedure" to inhibit REM sleep. During this procedure, the animal is placed on a small platform, whose top protrudes above the surface of surrounding water. The platform is so small that

with the loss of postural muscle tone at the onset of each REM period, the animal is awakened as it begins to fall toward the water. This procedure presents many practical difficulties. It has been claimed for example that control animals (on larger platforms) are REM deprived as much as experimental animals (Stern, 1970), and if that were so, then experimental and control differences in dependent variables could not be due to REM sleep deprivation. It has also been claimed that the platform technique, introduces several confounding variables, namely, stress, confinement, dampness, loss of total sleep time, arousals and weight loss. Vogel (1975) goes as far as to state that if the technique is invalid, then the conclusion of most animal experiments on REM sleep deprivation are also invalid. Similarly, one could also argue that in human REM deprivation studies, the apparent psychological impairments could reflect performance decrements caused by the intrusion of sleep processes rather than direct impairment of learning and memory (Chernik, 1972).

Other researchers, however, are less radical and feel that enough evidence has accumulated to allow certain conclusions (Greenberg & Pearlman, 1974; Hennevin & Laconte, 1971; Stern, 1971). Greenberg and Pearlman, for example, suggest that, on the basis of a prepared-unprepared learning continuum, the confusion between negative and positive results observed in REM deprivation studies

be clarified. Prepared learning occurs quickly and involves little change in the animals behavioural repertoire, whereas unprepared learning takes longer, requires adaptive change in behavioral strategy and thus, might involve a REM sleep information-processing mechanism. For example, learning of a position habit in a Y-maze required 2-3 sessions (prepared learning) whereas comparable mastery of a brightness discrimination required 12 sessions (unprepared learning); the position habit was unaffected by brief post-trial REM deprivation whereas the brightness discrimination was greatly impaired (Pearlman & Becker, 1973). Similarly, one-way avoidance in rats was acquired in a few trials and was unaffected by post-trial REM deprivation, whereas two-way avoidance required extensive training and was essentially abolished by brief post-trial REM deprivation (Leconte & Hennevin, 1973). Furthermore, it is in this frame of reference that Greenberg, Pearlman, Finger, Kantrowitz and Kawliche (1970), Pearlman and Greenberg (1974) suggest that, in humans, emotionally "significant" material gives REM an opportunity to integrate experiences in a person's characteristic manner.

In brief then, REM deprivation studies present many confounding variables and conclusiveness as to a functional relationship with

learning by using such experimental methodology (REM as independent variable) is still quite premature. However, the specific relationship between REM sleep and learning becomes clearer with EEG studies of REM sleep following training (REM sleep as a dependent variable). LeConte, Hennevin, and Bloch (1973) reported that while rats were learning shuttlebox avoidance, they showed a significant elevation of REM sleep during the first hour of sleep (within 3 hours) after training. Animals whose performance had reached a plateau after a few days of training and those who failed to learn the avoidance response did not show this increase. Lucero (1970) reported similar findings following complex maze learning in rats and Fishbein (1973) found increased stage REM in mice after one-way avoidance training. Similarly when previously isolated kittens were placed in an enriched environment, the amount of REM rebounded by 40% compared with control levels; the high percent of REM being attributed to a rapid reorganization of behaviour (McGuinty, 1969).

Using a more stringent experimental design, Hennevin, LeConte and Bloch (1974) conducted an experiment where twenty male Wistar rats were studied after a period of habituation to water deprivation and recording conditions. After three days of baseline measurement, the animals were placed in a Skinner box where, for six minutes they could receive water by pressing a bar.

Immediately after these learning sessions, sleep phases were measured during a three hour recording period. They observed a REM sleep ratio increase after the second and third sessions of learning and a return to reference level in the fourth and fifth sessions. Extinction and relearning were then studied in eleven of the animals. Each of these situations was followed by an increase in the REM sleep ratio after the first session and a return to reference level on the following days. Smith, Kitahama, Valatx and Jouvet (1972) reported a significant increase in REM sleep during acquisition of a shock avoidance task. To determine the generality of these results, a later study was done by Smith and Lowe (1975) to study acquisition of an avoidance discrimination task on REM sleep; results were inconclusive. However, it was interesting to note that by separating the animals into a "bright" and "less bright" group on the basis of number of days that it took to learn the task, there was an indication that the bright animals had shown a slight (but not significant) increase in REM sleep. In a study with mice Pagel and Pegram (1976) have shown that not only does REM sleep increase in different strains of mice classified as poor, good and better learners but better learners have the highest REM percent. Most of these animal studies reinforce the hypothesis claiming the importance of REM sleep in information processing.

Very few human experiments have been conducted where REM sleep was treated as a dependent variable. Castaldo (1973) has reported a study where a group of mentally retarded children submitted to an 18 month intensive training program showed increase REM percent as compared to a control group. In another study Castaldo and Krinicky (1973) found that subjects who were told that they would be paid every morning for the recall of non-significant paired associates showed a REM increase and a better recall as compared to nights where they had no reinforcement. Lewin and Gombosh (1972) reported a significant increase in REM time in subjects that were asked to spend 4 hours during the evenings in a confused atmosphere in which they were asked to do a number of difficult tasks without explanation. Results of the few human studies suggest a possible role of REM sleep in integrating emotional and cognitive data. However, these researches show few controls of non-specific variables associated with the experimental manipulations. One of the major flaws is the difficulty in evaluating adequate waking behaviour. Most studies for example, lack control of the subject's daily activities to check for various complicating factors such as mood, level of stress and mode of learning.

With these methodological difficulties in mind and in the hope of clarifying previous confounding results (Allen et al., 1972; Zimmerman et al., 1970), Prévost (1976) investigated the effects of visual inversion on REM sleep using a more stringent

experimental design. While observing a significant increase in REM time, thus supporting Dewan's "P" hypothesis, his results strongly suggest that an increased demand for the processing of new information during REM sleep is also associated with a decrease in phasic activity rather than an increase as previously assumed (e.g. Bloch, 1973; Dewan, 1970; Feinberg & Evarts, 1969; Hennevin & Leconte, 1971). According to Prévost, it is possible that a decrease in the indices of REM intensity would facilitate the formation and revision of functional structures in the brain. This implies that a decrease in REM intensity would not necessarily diminish the need for REM sleep and that the phasic distinction may offer means of recognizing important intra-REM variations. Furthermore, dream content analysis revealed that following inversion of the visual field, dreams were more confusing, contained significantly more motor and visual activities and direct incorporations of visual inversion. Besides controlling for many of the confounding variables found in the few human researches that study REM as a dependent variable, this last study's major contribution lies in its suggestion that individual variations in REM, dream intensity and dream content be dealt with, not as totally independent from each other but by means of a more comprehensive "psychobiological" theory.

In short, the last few years have witnessed some positive indications relating REM sleep to processes of learning and memory. However, the issue seems quite far from being clarified. Methodological and interpretational ambiguity obscure the question, as is evident when subdividing the pertinent research along the main methodological lines.

1. Studies of short, long and variable sleepers stress: that future research dealing with functions of sleep should emphasize carefully controlled analysis of individual differences.
2. Studies that show a decrease in retention as a consequence of REM deprivation: some methodological ambiguities tend to make the results and their interpretations inconsistent; for example, problems of the pedestal techniques and problems of interference with the normal periodicity of sleep patterns.
3. Studies purporting to show an increase in REM sleep as a consequence of massive learning or learning in an enriched environment: even with successful results, the problem of interpretation still lingers on.

### Dreaming and Environmental Mastery

Many researchers approach the dream as being continuous with waking thought. Although theories vary in some respects, each acknowledges that the dream facilitates the dreamer's mastery over the environment.

Klein (1967) maintains that there is a close relationship between daytime thoughts and the dreams of the night, seeing dreams as one mode of carrying on a series of ideas that may have been set in motion during the day. Building on this model, Fiss (1969) conceptualizes the need to dream as a need to complete unfinished tasks. According to him, unresolved cognitive-emotional tasks constitute problems which strive toward completion during the night.

While Pearlman (1970) also believes that dreams play a role in solving problems, he proposes that dreams function specifically to facilitate the emotional assimilation that gives adaptive reality to a problem solution. Similarly, Breger (1967) points out that the dream state has a number of advantages over waking consciousness for dealing with emotional material. He believes that in dreams, stored information is more readily available in the sense that associational processes are more fluid, the criterion of social acceptability is at a minimum, and a greater variety of means for manipulating symbols is available. The overall effect is a creative opening up of the memory systems.

Not all dream researchers would agree with the above notion that dreams facilitate mastery of the environment. In fact, some suggest that dreams may serve an adaptive function through a compensating mechanism. Thus, Wood (1962) observed that following a period of social isolation, subjects' dreams had an increase in social content. Similarly, Hauri (1967) found that following a situation where subjects had to resolve complex problems their dreams contained less problem related contents as compared to baseline nights. In the same vein, Foulkes, Pivik, Steadman, Spear and Symonds (1967) found that following the presentation of a baseball film, dreams of young males were more aggressive than dreams following a western film, suggesting compensation on the hostility dimension.

These results are difficult to explain in the light of the theories that give REM sleep a function of problem solving or information processing of daily activities.

In the present study, it was our purpose to observe in what way intensive learning of a second language influenced dream content. It was, however, difficult to predict how the dream contents obtained would fit in with the different functions of dreaming. Initially questions arose such as: would dreams incorporate elements of the new language for integration purposes?; will verbal material of dreams be in the maternal language in order to compensate for needs developed during the day?; and could

incorporation of French elements in the dreams reflect mastery of the second language? In terms of dream content, this study was therefore mostly exploratory.

### Research Hypothesis

That sleep should have some function involving aspects of memory and learning is certainly believable, although evidence is as yet not entirely convincing. It is intriguing to notice that so many investigators have come up implicitly or explicitly with similar theories in recent years.

Intensive learning of a second language introduces an added requirement for the assimilation of new information. This provides an excellent occasion to examine the idea that an increased demand for REM sleep as well as dream content alterations could be expected to follow such a situation of intense learning. The present study examined this problem by asking four students to sleep in the laboratory where their sleep cycle and dream content were monitored before, during and after a French immersion course. The major research hypotheses tested in this study are as follows:

a) REM percent:

According to Dewan's "P" hypothesis, one should expect an increase in REM percent following intensive learning of a second language.

b) REM latency:

According to Dewan's "P" hypothesis a decrease in the latency of the first REM period should be expected following intensive learning of a second language.

c) REM density:

According to Dewan's "P" hypothesis phasic activity as indexed by measures of REM burst activity should increase following intensive learning of a second language.

Dream Content

Dewan's "P" hypothesis - that REM sleep is involved in the reorganization of functional structures - does not make direct predictions at the level of dream content. However, theories that give dreaming an adaptive function of facilitating the dreamer's mastery over his environment (Breger, 1967; Fiss, 1969; Klein, 1967; Pearlman, 1970) can permit one to make certain hypotheses that might indirectly bring support to the idea that REM sleep reflects organization of functional structures in the brain. Thus, one could tentatively hypothesize in the present study that:

1. Dreams collected from REM sleep in the experimental session should have more direct incorporations of the new language for integration purposes as opposed to those collected from the control sessions.

2. One could also expect a high degree of cognitive, as opposed to visual or physical, activity in dreams collected from the experimental session.
3. At the level of emotional content of dreams, one could expect more confusion following intensive learning of a second language.
4. In the same vein, cognitive disturbance could be expected to occur more often in the experimental session as opposed to control sessions.

## CHAPTER III

### Methodology

#### Design

The basic objective of this study was to examine sleep characteristics and dream content of subjects undertaking an intensive second language course. Four subjects slept for three sessions of six consecutive nights in the laboratory, while their electroencephalographic (EEG) activity, muscular tonus (EMG) and eye movements (EOG) were continuously recorded.

The first series, a control session, began two weeks prior to the course, while the experimental session was held mid-way through the French immersion course. The third series was done as a post-course control session in the first weeks following the end of the course. For each subject, the first two nights of each session served the purpose of adaptation to the laboratory situation. The third and fourth nights served to gather uninterrupted sleep cycle data and the last two nights were for dream collection. Table 1 presents the sequence of nights spent in the laboratory.

On the first four uninterrupted nights of each series, subjects slept between seven and eight hours depending on their usual sleep habits; the time at which recordings began and ended for each subject remained constant throughout the experiment.

Table 1

## Sequence of Nights Spent in the Laboratory

	CONTROL SESSION I (Pre-Course)	EXPERIMENTAL (Course)	CONTROL SESSION II (Post-Course)
ADAPTATION	1st night 2nd night	7th night 8th night	13th night 14th night
SLEEP CYCLE	3rd night 4th night	9th night 10th night	15th night 16th night
DREAM COLLECTION	5th night 6th night	11th night 12th night	17th night 18th night

## Subjects

Four male English speaking subjects, ages 18, 18, 19, and 20 who were registered in the French Immersion Summer Course (Ecole française d'été) offered by the University of Ottawa were chosen for the experiment. The subjects were selected on the basis of the Minnesota Multiphasic Personality Inventory test, a sleep habit questionnaire (Appendix A), and an interview. The selected subjects did not present physical or psychological disabilities. During the interview, subjects were given general information about sleep research and visited the laboratory. They were also instructed that, during the study they would be required to keep a record of their daily activities. Subjects were paid \$180.00 (\$10.00 per night) after the study was completed.

## University of Ottawa French Immersion School

Since 1969, the University of Ottawa has been offering a credited six week total immersion course in French under the auspices of the Provincial and Federal Governments' summer language bursary program. Students were eligible for the course provided they were Canadian citizens, had general post secondary standing, were enrolled as full-time students during the previous academic year, and were at least 17 years of age. Tuition fees,

room and board, food allowances, University facilities, and most socio-cultural activities were covered by the bursary. The course FRE 1651A is worth six credits at the University of Ottawa; students from other institutions are granted equivalences.

All students were required to live on the campus, sharing a double room with a Francophone student from the English Summer School. A maximum of 15 students per class were grouped according to their level of proficiency. All students were tested in order to divide them into homogeneous groups to of low, intermediate and advanced levels. One qualified language teacher was assigned to a group for the six week program.

The program was held Mondays through Fridays (with some weekend activities) and comprised approximately six hours of daily supervised activities. Morning classes, from 9:00 o'clock to 12:00 o'clock emphasized oral skills with the use of audio-visual materials and a language laboratory. The standard textbooks used in those classes were of the series: Le Français International, 2e version.

Morning classes were regrouped for afternoon seminars - held from 13:15 o'clock to 16:15 o'clock - to learn the language through its cultural aspects. Every week, groups rotated and studied a different cultural module, thus meeting six different seminar leaders during the program. The aim of these afternoon seminars

was to give students an insight into French Canadian culture through informal seminars on songs, television and radio programs, newspapers and magazines, plays, films and books, also through artistic and scientific productions in French Canada, and the study of " la francophonie" in Canada and in the world. A variety of social and cultural activities was planned in order to offer students different opportunities to practice their French in a natural context, such as participation in Festival Canada, a weekend in Québec city, social gatherings, sing-songs, dances, wine and cheese parties, amateur shows, visits to cultural centers, films, sports and picnics. A summary of the program and the description of a typical day are given in Appendix B.

#### Physiological Recording

Electroencephalographic (EEG) activity, muscular tonus (EMG) and eye movements (EOG) were amplified, recorded and monitored on a Nihon-Kohden eight-channel multipurpose polygraph model RM-85 with an eight-channel oscilloscope monitor model VC-85. Position of electrodes and recording procedures were done as suggested by the standardized manual (Rechtschaffen and Kales, 1968). Two Grass EEG E56H gold cup electrodes and, for the EMG and EOG, flat disc Grass E45 electrodes were used. These

electrodes were filled with Beckman Offner isotonic saline electrode jelly and attached with appropriate adhesive tape (EOG, EMG) or collodion (EEG). The inter-electrode impedance was always less than 5 Kohms at the beginning of each recording. Speed of paper was maintained at 10 mm/sec throughout the experiment.

#### Subjective Stress Scale

Since it was felt that participation in the course could produce a fair amount of stress and thus affect sleep pattern perhaps reducing REM sleep, subjects were asked after each session to rate on a subjective 1-10 scale how much stress they experienced during each of the three monitoring periods.

#### French Efficiency Tests

Scores were obtained on the progress made in French, as measured by standardized pre- and post-course tests.

#### Mood Adjective Checklist (MACL)

Before and after each night's recordings and after each dream collection, the experimenter read through the intercom the modified Nowlis mood checklist (Nowlis, 1965), and the subjects' responses were noted on a special form (Appendix C). This

checklist consists of 24 adjectives to which the subjects respond on a four point scale. Groups of three adjectives fall into eight categories: aggression, anxiety, surgency, social affection, depression, distrust, quiet and detached and total scores on each category could vary from zero to nine. In addition, on dream collection nights, subjects were asked to give their judgment of five other sleep and dream dimensions: dream active, you active, dream busy, how vivid, and sleep depth (Koulack, 1969).

#### Dream Collection Procedure

On nights 5 and 6 of each condition, subjects were awakened during REM periods by an 85 decibel buzzer and were asked to report their dreams. Subjects were awakened after 5 minutes of REM sleep for the first REM period, after 10 minutes for the second REM period, 12 minutes for the third and two additional minutes for each subsequent REM period.

Prior to sleep, subjects were instructed to report, immediately upon hearing the buzzer, anything that had been going through their minds. They were encouraged to describe their dreams in as much details as possible, including descriptions of surroundings, activities, feelings, thoughts and people involved in their dreams. During the actual report, the experimenter interfered as little as possible, limiting the interventions to encouragements or repetitions of the subject's last words. If after the buzzer

the subject did not start to report, the experimenter asked the standard question: "Was there anything going through your mind?" When the subject had completed his report the MACL was administered.

### Analysis of Data

#### Physiological Measures

Sleep stages of nights 3 and 4 of each condition were scored blind as to the condition under which they occurred. The data was analysed in epochs of 30 seconds and by the criteria suggested in the Rechtschaffen and Kales (1968) standardized manual. REM latency and REM time were independently scored by an experienced judge. The scorer's rater reliability was assessed by correlating his analysis with that of another scorer (the experimenter) on all protocols; the correlation was .97 for REM latency, .94 for REM time and .92 for REM density. Other measures of sleep were defined and scored as follows: sleep latency was defined as the interval between the time lights were closed and sleep onset, and REM latency as the interval of time between sleep onset and the first REM period. Indices of REM intensity were derived by counting the number of three second epochs which contained at least one rapid eye movement of 50  $\mu$ v or more. A REM burst was defined as three or more such epochs occurring consecutively. Division by the total number of three second epochs in REM sleep yielded REM density measures.

### Dream Content Analysis

Two judges independently analyzed one hundred and twelve dreams blind as to the condition under which they were obtained. The Hall and Van de Castle (1966) scales of Social Interaction, Activity, Success-Failure, Good Fortune, Misfortune and Emotions were used. A scale of Participation (Prévost, 1974) and one of Cognitive Disturbance (Breger, Hunter and Lane, 1971) were also used. For the purpose of this particular study, a Verbal Content scale was added by the experimenter. A sample of a scoring sheet with the different scales is provided in Appendix D.

Percentage of agreement between the ratings of two judges on 20 dreams, taken at random from the different conditions, were computed and used as reliability criteria. The inter-judge reliability scores on the different scales are presented in table 2. Scales that had percentage of agreement below .70 and those that rarely occurred in dream contents were eliminated.

### Statistical Analysis

Two tailed t-tests for correlated groups were used to calculate if there were significant differences between the mean values of the control sessions and the mean values of the experimental session. This statistic was used for physiological measures of REM sleep as well as for dream content measures. A .05 level of significance was used.

Table 2

Inter-Judge Reliability for Dream Content Scales  
as Measured by Percentage of Agreement

<u>Aggression</u>			<u>Success</u>	
Directed	.95		Personal	.95
Received	1		Success of Others	1
Neutral	.95			
<u>Friendliness</u>			<u>Failure</u>	
Directed	.85		Personal	1
Received	.85		Failure of Others	1
Neutral	.95			
<u>Sexuality</u>		*	<u>Fortune</u>	
Directed	-		Personal	.95
Received	-		Fortune of Others	1
Neutral	-			
<u>Activity</u>			<u>Misfortune</u>	
Physical	.75		Personal	.95
Visual	.80		Misfortune of Others	.95
Auditory	.90			
Cognitive	.90		<u>Emotions</u>	
Movement	.95		Anger	.90
			Joy	.95
			Confusion	.95
			Sadness	1
<u>Verbal Content</u>			Anxiety	
French	1			.45*
English	1		<u>Participation</u>	
Dreamer Alone	.95		Nil	.90
Dreamer & Other	.85		Passive	.85
Others	.95		Active	.80
Fragmented French	1		Marked	.85
French in Report	1			
			Cognitive Disturbance	.75

\* Rejected Scales due to lack of occurrence or low reliability.

## CHAPTER IV

### Results and Discussion

#### Effects of Intensive Learning of a Second Language on REM Sleep.

Individual physiological measures of REM sleep on baseline nights 3 and 4 for experimental as well as for control sessions are presented in table 3. Data for sleep stages 1, 2, 3 and 4 are given in table 4. Supplementary physiological data are given in Appendix E. Table 5 presents means, standard deviations and t-tests of the physiological measures related to the different research hypotheses.

For all of the physiological research hypotheses investigated in this study, tests of significance between means of the control and experimental sessions were nonsignificant. In addition, no significant differences were observed between the two control sessions. The postulated increases in REM sleep parameters following intensive learning of a second language were not supported.

However, a closer examination of REM sleep characteristics in relationship to stress and learning revealed interesting observations. Indeed, subjects 1 and 2 who showed increases in REM sleep did not report increases in their subjective stress scales during the experimental session, and made reasonable progress in French whereas the reverse was true for subject 4. Subject 3 showed no differences on all three measures (Table 6).

Table 3

Individual Physiological Measures of REM Sleep  
for Control and Experimental Sessions

Subject	Control I			Experimental			Control II		
	Night 3	Night 4	$\bar{X}$	Night 3	Night 4	$\bar{X}$	Night 3	Night 4	$\bar{X}$
REM Latency (in minutes)									
1	62.50	64	63.25	62.50	64.50	63.50	69	114.50	91.75
2	92.50	129.50	111	76.50	120.50	98.50	59	81	70
3	154.50	60.50	107.50	142	77.50	109.75	60.50	46.50	53.50
4	163	131	147	149	184	166.50	133	87.50	110.25
REM Time (in minutes)									
1	105.50	109	107.25	142.50	114	128.25	96	106.50	101.25
2	91	90	90.5	129	113.50	121.25	90	49	60.50
3	119	80.50	99.75	107	99.50	103.25	105.50	107.50	106.50
4	116.50	112	114.25	98	84.50	91.25	102	114	108
REM Percent									
1	24.14	24.72	24.43	30.25	24.65	27.45	20.10	22.46	21.28
2	21.69	19.09	20.39	27.27	24.25	25.76	19.13	10.80	14.97
3	30.20	18.72	24.46	25.12	23.63	24.38	25.05	25.50	25.27
4	24.49	23.93	24.21	21.19	18.15	19.67	21.56	24.33	22.94

Table 3 (Cont'd)

Subject	Control			Experimental			Control		
	Night 3	Night 4	$\bar{X}$	Night 3	Night 4	$\bar{X}$	Night 3	Night 4	$\bar{X}$
REM Density									
1	.1616	.2050	.1833	.1677	.2237	.1957	.2755	.1197	.1976
2	.2165	.3794	.2979	.1884	.2476	.2180	.2811	.2735	.2773
3	.1042	.1211	.1126	.1635	.1357	.1496	.1531	.2730	.2130
4	.3644	.2870	.3261	.2928	.3757	.3342	.1902	.3092	.2497
Sleep Latency (in minutes)									
1	3.50	3.50	3.50	8.50	17	12.75	2.50	4	3.25
2	15	8.50	11.75	7	13.50	10.25	9.50	24.50	17
3	4	4.50	4.25	5	1.50	3.25	17	12	14.50
4	18.50	12	15.25	17	14.50	15.25	6	11.50	8.75
Total Time Spent in Bed (in minutes)									
1	437	441	439	471	462	466	477	474	475.50
2	434.50	471.52	453.01	473	468	470.50	470.50	453.50	462
3	394.	430	412	427	421	424	421	421.50	421.25
4	476.50	468	472	462	465.55	463.75	467	466.50	466.75
Sleep Time (in minutes)									
1	426	432	429	466	457	461.5	473	468.5	470.75
2	397	467	432	469	452	460.5	456	391	423.5
3	384.5	392.5	388.5	416	401.5	408.75	398.5	407	402.75
4	458	459.5	458.75	452.5	461.5	457	469	460.5	464.75

Table 4

Sleep Stages (%) for Baseline Nights 3 and 4

Subjects	Stages	Pre-Course	Course	Post-Course
1	I	8.55	10.15	10.02
	II	44.25	42.05	45.10
	III & IV	20.55	18.90	19.40
	REM	24.43	27.45	21.28
	*O & MT	2.22	1.45	4.20
2	I	8.70	8.90	10.50
	II	43.40	40.15	39.40
	III & IV	23.65	23.20	21.00
	REM	20.39	25.76	14.97
	O & MT	3.96	1.99	14.08
3	I	10.30	9.30	9.10
	II	44.40	44.70	40.70
	III & IV	16.55	20.90	22.70
	REM	24.46	24.38	25.27
	O & MT	4.29	.72	2.23
4	I	9.60	8.90	7.65
	II	42.75	48.15	44.55
	III & IV	21.60	21.60	23.55
	REM	24.21	19.67	22.94
	O & MT	1.84	1.68	1.31

\* Stage 0 = Awakening  
 MT = Movement Time

Note: t-tests computed on these measures reveal that there were no significant difference between conditions.

Table 5

Means, Standard Deviations and Related  
t-tests of the Physiological Measures

Variables	$\bar{X}$ Controls	SD Controls	$\bar{X}$ Experi- mental	SD Experi- mental	t (df=3)
REM Latency	94.28	20.41	109.56	37.03	1.32
REM Percent	22.25	2.73	24.32	2.89	.78
REM Density	.2322	5.64	.2244	6.80	.33
Burst Density	.05	.001	.05	.011	.64
Sleep Latency	9.79	4.10	10.57	4.51	.22
Sleep Time	433.75	29.06	446.94	25.53	1.72

$$t = .05 \text{ (df} = 3) = 3.18$$

Table 6

REM %, Stress Scores and  
French Proficiency Scores

Subject		Pre-Course	Course	Post-Course
1	REM %	24.43	27.45	21.28
	Stress	1.5	2.0	1.5
	Exam (%)	77.0		85.0
2	REM %	20.39	25.76	14.97
	Stress	2.0	2.0	2.0
	Exam (%)	46.0		55.0
3	REM %	24.46	24.38	25.27
	Stress	3.0	5.0	2.0
	Exam (%)	38.0		41.0
4	REM %	24.21	19.67	22.94
	Stress	1.5	6.0	2.0
	Exam (%)	36.0		36.0

In order to statistically evaluate the degree of relationship between REM parameters, learning, and stress, Pearson correlation coefficients were computed (Table 7). The correlation between REM percent and learning was found to be highly positive (.98,  $p < .05$ ), whereas the correlation between REM percent and stress was highly negative (-.98,  $p < .05$ ). Other correlation coefficients seem to be worth discussing even though they are not statistically significant. The correlation between REM latency and learning was .87 ( $df = 2$ ); between REM latency and stress -.86 ( $df = 2$ ), between REM density and learning -.76 ( $df = 2$ ) and, finally, .79 ( $df = 2$ ) between REM density and stress.

Correlation coefficients obtained in this study do offer certain indices of relationship which are consistent with some of the postulated research hypotheses. Thus, an  $r$  of .98 ( $p < .05$ ) for REM percent and learning endorses Dewan's idea that one should expect an increase in REM percent following intensive learning. The second postulated hypothesis in this study, which states that a decrease in the latency of the first REM period should be expected following an intensive learning situation also shows a certain trend for support of Dewan's "P" hypothesis: subjects 1 and 2 who showed increased learning, had lower REM latencies in the experimental session as compared to subjects 3 and 4 who had

Table 7

Pearson r Coefficients for Correlated  
Physiological and Psychological Variables

Variable	Pearson r	Value of P
REM % - Learning	+ .98	< .05
REM % - Stress	- .98	< .05
REM Density - Learning	- .76	> .1
REM Density - Stress	+ .79	> .1
REM Latency - Learning	+ .87	> .1
REM Latency - Stress	- .86	> .1

df = 2, p < .05 = .95

longer latencies ( $r = -.87$ ,  $df = 2$ ). The obtained correlation for the last physiological hypothesis which predicted increases in REM density following increased learning was in the opposite direction from what Dewan proposes ( $r = -.76$ ,  $df = 2$ ). It is, however, interesting to note the decreases in the indices of REM density might reflect a decrease in total phasic activity, consistent with de la Pena's "SCIP" hypothesis which proposes that the amount of phasic activity during REM sleep is reciprocally related to the amount of sensory stimulation prior to sleep. In support of this notion, Prévost (1976) has found that decreases in the indices of REM density in conjunction with significant increases in REM sleep percentage following a situation of intensive learning (visual inversion). This finding is in agreement with the general notion that REM sleep is directly involved in the formation of new "programs" in the brain. It further suggests that de la Pena's and Dewan's hypotheses may not be as contradictory as they seem to be (Prévost, 1976). More specifically, in a review on the emergence of a tonic-phasic model for sleep and dreaming, Grosser and Siegal (1971) suggest that the isolation of a number of apparently correlated events within stage REM indicates that the stage REM period might not be a homogeneous event, as the NREM-REM dichotomy implies. They point to the fact that the tonic-phasic distinction might

undermine the traditional NREM-REM model by seeming to require qualitatively different kinds of mechanisms for the explanation of tonic-phasic events within the REM stage. While one must continue to be suspicious of the adequacy of any simple, dichotomous model, the tonic-phasic distinction may offer means for recognizing important intra-REM variations and similarities as well as differences between stage REM and other sleep stages. It thus seems important to pursue research in the area of learning and sleep with special attention to phasic activity.

An interesting observation in this study was the highly negative correlation between REM percent and subjective stress scores ( $r = -.98$ ,  $p < .05$ ). This result brings into focus the whole realm of research on psychological stress which suggests that subjects react in widely different - and sometimes even opposite - ways to stimuli which are, objectively, "the same". In the present study, subjects did react in differing ways to the input experience of intensive learning of a second language. This finding also suggests an alternate interpretation of the present findings. It has been observed that stress can reduce REM sleep percentage (Snyder, 1972), thus it is possible that subjects 3 and 4 who did not exhibit increases in REM sleep during the intensive French course did so because of the stress involved in the course. Consequently, stress may have diminished and in some cases inhibited the need for REM sleep following learning.

Effects of Intensive Learning of a Second Language on Dream Content.

Statistical analysis of dream content variables are presented in table (8). None of the t-test statistics yielded significant results. There were, however, tendencies toward significance ( $p < .1$ ) on a few of the dream scales.

The first assumption, that dreams collected in the experimental session should have more direct incorporations of the new language as opposed to those collected from the control sessions was not confirmed. However, results on the different verbal communication scales suggest that there was a general propensity for dreams following intensive learning of a second language to incorporate more verbal communication elements irrespective of the specific language (e.g. dreamer talking to himself; dreamer talking to others; others talking to dreamer). It might also be pertinent to note that a certain degree of relationship, even though not significant, seems to exist between those who showed increases in learning and increases in verbal communication elements in their dreams ( $r = .71$ ,  $df = 2$ ). An example of verbal communication incorporated into a dream is given in Appendix F. Indeed, when all these different scales were pooled to a single 'verbal communication' scale and a t-test was performed between the experimental and control conditions, a tendency towards significance was observed ( $t = 2.86$ ,  $p < .1$ ).

Table 8

## Statistical Analysis of Dream Content Variables

Scale	Control Nights	Experimental Nights	t
<u>Social Interaction:</u>			
Directed Aggression	.0288	.0425	.356
Received Aggression	.0425	.1025	1.33
Reciprocal Aggression	.1000	.0425	1.09
Total Aggression	.0560	.0625	.279
Directed Friendliness	.1150	.1675	.609
Received Friendliness	.1063	.1400	.420
Reciprocal Friendliness	.0250	.0	1.00
Total Friendliness	.0818	.1000	.584
<u>Activity:</u>			
Physical	.4700	.3250	1.11
Mouvement	.4325	.4775	.550
Visual	.6925	.6000	.859
Auditory	.1000	.0900	.175
Cognitive	.0725	.2475	2.96*
<u>Verbal Communication:</u>			
French	.0	.1700	2.04
English	.2100	.3575	1.75
Dreamer Alone	.0300	.1325	1.45
Dreamer and Other	.2000	.3525	1.12
Other	.0675	.1875	1.19
Fragmented French	.0175	.0625	1.08
Total Verbal Communication	.0875	.2150	2.86*
French in report	.0175	.2900	1.57
Total Misfortune	.0625	.0225	1.49

Table 8 (Cont'd)

Scale	Control Nights	Experimental Nights	t
<u>Emotions:</u>			
Anger	.1425	.1725	.277
Joy	.1650	.1850	.165
Confusion	.1150	.0700	1.23
Sadness	.0725	.0325	1.53
Total Emotions	.1075	.1175	.183
Anxiety	.9575	1.06	.677
<u>Participation:</u>			
Nil	.1250	.0850	.671
Passive	.1700	.1925	.268
Active	.3425	.2550	1.83
Marqued	.2375	.4175	1.95
Total Participation	.2175	.2350	.887
Cognitive Disturbance	1.425	1.725	1.45

\*  $t = 2.35, p < .1$

According to the second hypothesis, one should expect a higher degree of cognitive activity in dreams collected from the experimental session as opposed to those collected from control sessions. Here again, the hypothesis was not statistically confirmed even though a tendency towards significance was observed ( $t = 2.96, p < .1$ ). Furthermore, in the light of a possible continuation of this study, a Pearson correlation coefficient reveals that there is a tendency for those who showed improvement in the learning of a second language (subjects 1 and 2) to have a greater amount of cognitive activity incorporated into their dreams ( $r .84, df = 2$ ). This observation is congruent with the notion that cognitive tasks (such as language learning) constitute problems which strive toward completion during the night.

Along the dimension of emotional content of dreams, it was hypothesized that there would be more confusion following intensive learning of a second language. This hypothesis was not confirmed. Finally, the last hypothesis predicted that an increase in cognitive disturbance should be expected in dreams collected from the experimental session as compared to those collected from control sessions. This hypothesis was not supported.

Dream Recall.

A specific scale for measuring proportions of non-recall of dreams as well as other possible variations in reports that were not scored as dreams (such as "thought-like" activity) was not systematically used in this study. On a post-hoc basis however, it was found that, on the whole, subjects tended to have less dream recall during the experimental session as opposed to the control sessions (Table 9). Here again, it is interesting to note the consistency in the differences between subjects: subjects 1 and 2 who showed increases in learning tended to report less dreams during the experimental session as opposed to subjects 3 and 4 ( $r = -.88$ ,  $df = 2$ ). Furthermore, in terms of differences between conditions, when a correlation coefficient was computed between subjects' stress scores and their respective proportions of dream recall, an  $r$  of  $.92$ ,  $p < .1$  was found. This would seem to bring some support to the salience hypothesis of dream recall (Cohen & MacNeilage, 1974).

Also of interest were the differences in the proportions of thought-like activity between conditions. There was a  $.10$  proportion of thought-like activity during the experimental session as compared to a proportion of  $.01$  during the controls. It should be added that there were no detectable differences in terms of the amount of phasic activity immediately prior to REM arousals.

With regards to these observations, one wonders - according

Table 9

## Proportion of Dream Recall from REM Sleep

Subject	Control I	Experimental	Control II
1	.75	.64	.80
2	.70	.50	.67
3	.80	.67	.78
4	.80	1.00	1.00

---

## Proportion of Thought - Like Activity

	Control I & II	Experimental
1	.10	.18
2	0	0
3	0	.22
4	0	0
$\bar{X}$	.01	.10

to the contention that certain signs of waking EEG asymmetry are associated with specific hemispheric functions - if the peculiar type of mentation, perception, learning and responding occurring in sleep would be expected to markedly affect interhemispheric functions (Bakan, 1975; Broughton, 1975)? Under such a perspective, it would be interesting to see what kind of observations would be yielded following intensive learning of a second language.<sup>1</sup> Furthermore, it has been proposed that "thought-like" dreaming activity occurs in NREM sleep (Foulkes, 1962; 1967). Accordingly, mentation during sleep would alternate between being more thought-like in NREM sleep to being more hallucinatory in nature in REM sleep. Future studies could examine the differences that might exist in the organization and elaboration of sleep mentation collected from REM as well as from NREM sleep following intensive sessions of learning.

Mood Adjective Check List (MACL).

Individual scores on the modified Nowlis Mood Adjective Check List given before and after sleep as well as after each dream collection awakening are presented in Appendix G. There were no consistent and significant changes in the nine different scales between conditions. Nevertheless, there were observable

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1. Dr. Roger Broughton has actually proposed and tested this hypothesis in an ongoing study which began in 1974; the study is not completed.

inter-subject differences worthy of mention. An interesting observation is that the subjects had practically the same assessment on their MACL anxiety dimension and their Subjective Stress Scales, as indicated by a correlation of .91,  $p < .1$ . Other correlation coefficients computed between the MACL scales and learning reveal that subjects who had increases in learning tended to report their dreams as being more quiet ( $r .90$ ,  $df = 2$ ) and less distrustful ( $r -.76$ ,  $df = 2$ ) than subjects who did not show increases in learning. There were no observable changes in the aggression, surgency, social affection, depression and detached dimensions.

It is evident that results discussed thus far are tentative and should be interpreted within the framework of a limited study. Therefore, it must be emphasized that statistics computed with only four subjects do not have great power. More subjects will have to be studied before generalizable findings can be obtained.

Technical difficulties often encountered in sleep studies can have detrimental effects on results. Such an example in this study was the higher amount of awakenings and movement time percentages observed for subjects 1 and 2 in the post-course session (control II): these two subjects slept in adjacent rooms on the same nights and high meteorological temperatures on these specific days offer a possible explanation for the greater amounts of awakenings and movement time. Another

difficulty was in maintaining total sleep time constant for all subjects throughout the different conditions. Even though there were no significant differences in sleep time between conditions ( $t = 1.72, p > .1$ ), more spontaneous awakenings in the morning seemed to have occurred during the control sessions as compared to the experimental session where subjects generally complained that they were more tired. On a more methodological point of view, subjects 1 and 2 who scored higher on their French proficiency tests given prior to the course, were subsequently assigned to intermediate level classes, whereas subjects 3 and 4 were assigned to low intermediate classes; this lack of homogeneity between subjects may act as a contaminating variable which might explain both lack of statistical differences (t-tests) and inflated correlation coefficients. Finally, one could add that variables such as individual differences in motivation to learn a second language, in learning abilities, and in subjective evaluation of stress may have also influenced the obtained results.

There are still many theoretical as well as methodological problems to be resolved in the area of sleep research. Thus, in the absence of adequate knowledge of the processes involved the question remains as to whether it is possible to associate a hypothetical function of brain restitution to the function of

memory solely by observing a correlation between amount of learning and amount of REM sleep. With respect to the present study and the other few studies that have examined REM sleep as a dependent variable in humans, it would appear that researchers should look more at individual differences in physiological reactivity to stimuli during the day before we can hope to find reliable physiological indices of dreaming during the night. Similarly, one could possibly make more sense out of nighttime differences between subjects, if we first found what the subjects' waking memory and learning processes were like.

## CHAPTER V

### Conclusion

Conclusions from this study are limited until currently analysed results of more subjects are added. Nevertheless, based on the few human studies that have studied REM sleep as a dependent variable, results of the present study seem to offer some evidence which is consistent with the idea that under intense conditions of learning there should be a greater need for REM activity.

One interesting question that arises is whether fluctuations obtained in REM percent reflect learning efficiency, stress, or both. Thus, a closer look into specific learning processes involved, more attention given to individual differences, as well as more stringent experimental control of elements such as stress, could probably add more insight into the phenomenon of learning and sleep. Furthermore, greater sophistication of dream content analysis in terms of what learning processes are studied could also help yield interesting observations as to what the mind does at night and its relationship to waking behaviour.

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APPENDIX A

Sleep Habit Questionnaire

NAME

PRESENT ADDRESS

ADDRESS DURING THE SUMMER

TELEPHONE

SEX

MARITAL STATUS S M W D (Circle one)

DATE OF BIRTH

OCCUPATION

If you are a student, indicate: Faculty
Department
Year

History of disease or injuries: if other, please specify:

Allergic disease

- Hay fever
Asthma
Drug allergic
Drug reaction
Other

Blood Disease

- Anemia
Other

Skin Disease

- Acne
Other

B.B.N.T.

- Faulty Hearing
Faulty Vision
Wear glasses
Wear contacts
Speech defect
Other

Heart Disease

- High blood pressure
Low blood pressure
Irregular heart beats
Other

Pulmonary Disease

- Asthma
Shortness of breath
Chronic cough
Other

Nervous Disease

- Epilepsy
Tension headaches
Migrain headaches
Other

Digestive Disease

- Gastric ulcer
Nausea
Other

Kidney and Bladder

- Bed wetting
Other

Sleep

- Insomnia
Sleepwalking
Other

Are you currently under a doctor's care?
If yes, explain.

Are you currently under any medication?

Sleep Patterns

When do you normally go to bed?
When do you normally get up?
Do you have trouble going back to bed if awakened?
Do you generally have trouble sleeping in strange surroundings?
Would you classify yourself as a good sleeper?
poor sleeper?
fair sleeper?

How often do you dream? Once a night once a week once a month less than once a month

Do you have nightmares? once a night once a week once a month less than once a month

Have you ever participated in a sleep and dream experiment?
If yes, please describe:-

APPENDIX B

Summary of the French Immersion Program



Dear Student:

Welcome to the French Summer School of the University of Ottawa! We have received your thirty dollar deposit and you are now officially registered for the immersion course. We are pleased with the interest you have shown in our institution and hope that you will enjoy the experience. We look forward to meeting you. To simplify your arrival and stay here for six weeks, please read the following information carefully.

## 1. Residence

1. Bursary students are required to stay on the campus during the program.
2. Students from both Schools - English and French - will stay at the Stanton Residence, 235 Nicholas Street, which will be your address for the summer. The phone number is (613) 231-5400.
3. You will share a room with a francophone student of the English Summer School. However, since the number of students in both schools is not the same, some students will not have a french room-mate.
4. Linens are furnished and changed once a week. Please bring towels and beach towels.
5. There are kitchenettes at every two floors, each being equipped with a stove, a fridge, a table and chairs, plus a TV set in a small living room. Students may cook their own meals provided they bring along their own kitchen utensils.
6. The program starts on Monday morning, July 5, but you may arrive at the Stanton Residence, Sunday, July 4, starting at 12 noon. There will be a Welcoming Committee on Sunday, July 4, from noon to four o'clock, to meet you at the Residence desk.
7. The program ends on Friday, August 13, at noon, but you may keep your room till 10:00 a.m., on Sunday, August 15.

## 2. Meals

1. The cost of meals is covered by the bursary.
2. At the beginning of each week, starting Monday July 5 at noon, students will be issued a cheque in the amount of \$45.50, which should be quite sufficient to pay for three meals daily. You may use the Residence facilities or eat in the cafereria, which also offers a meal plan for \$6.50 a day for 3 meals, unlimited portions.

.../2



### 3. University Facilities

The \$2.00 registration fees entitle students to a card which gives them access to all University facilities:

#### 1. the University Centre offers:

a 350 seat theatre. The Agora and a shopping mall (Pivik, Unisport, Canadian Imperial Bank of Commerce, Zipper, Arts and Crafts, Watch Clinic, Sugar Bowl), two lounges, three typing rooms, two TV rooms, three music practice rooms, two arts-and-crafts workshops, a billiard hall, a table tennis room, a photo workshop, a reception and information desk, the university bookstore.

#### 2. the Sports Services, located in Montpetit Hall, 35 McDougall Lane, offer students a 50 metre swimming pool and three regulation-size gymnasias that can be combined into one large gymnasium. Other activity quarters contain lockers and facilities for weight training, sauna baths, dance, squash, handball, racquetball, judo, karate, physical fitness, etc.

#### 3. Health Services

The student Health Service is located at 43 Templeton Avenue. It is open Monday through Friday, from 8:30 a.m. to 4:00 p.m. Consultations are granted between 9:00 a.m. and 11:30 a.m. and between 2:00 p.m. and 4:00 p.m. It is preferable that students make an appointment beforehand.

The Student Health Service may be reached by calling 231-3957 at any time. Outside of office hours, an answering service will put students in touch with the doctor on call. Any call of an urgent or emergency nature will be looked after at any time, 24 hours a day, 7 days a week. Additional information as to the other services provided will be given to you upon arrival.

#### 4. What to bring:

Clothing and articles that are a must for the summer school:

- The vast array of socio-cultural activities require a variety of clothing: "warm" for evenings in the "open", "chic" for the Opera night at the National Arts Centre, "special" for the casino night, amateur theatre evening and "sports" for vigorous activities.
- Music is a continuous event in the Summer School: bring your instruments please.
- Memories are a heritage: cameras please!

- Souvenirs from your home town to exchange with classmates add a nice touch to "big family" living.
- Extra pocket money is strongly recommended: souvenirs, special events, etc...
- The trip to Quebec City is not to be missed - the limelight of the summer. The bursary only covers part of the expenses. You will be asked to contribute a small green bill (\$20.00).

## 5. The Course

The preceding information finds its raison d'être in the course itself, which is meant to be totally intensive. The staff is highly qualified and tremendously willing to help; it remains, however, up to the individual to participate and learn. The program is organized in such a way that those who are willing to learn will achieve a lot during the six weeks. Here are the conditions of learning offered by the program:

### 1. Formal learning

- a) three hours daily - five mornings a week - to learn the language as such;
- b) three hours daily - four afternoons a week - to learn the language through its cultural aspects and realizations.

### 2. Informal learning

- a) participating in group discussions with francophone students from the English Summer School;
- b) sharing a room with a francophone student;
- c) meeting francophone students in social activities like sports competitions, dances, picnics, etc.
- d) participating in cultural activities such as live concerts by famous French Canadian artists, theatre, films, visits, etc.

Students will be asked to speak French only throughout the program. For those who want more, there will be TV programs, films in the French cinemas of the area, and also a language lab open from morning to evening for individual practice.

Books: after the placement test, students will be grouped according to their level of proficiency in the language. Teachers will then determine the textbook to be used. The bursary covers the cost of one textbook which will be chosen from the series Le Français International, 2<sup>e</sup> version. Depending on the needs and the level of the class, you may be required to purchase an additional textbook (maximum \$5.00). Please feel free to bring dictionaries, grammars, french records, novels, games, etc...

6. The D Day, Monday, July 5

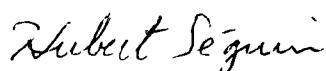
1. First meeting at nine a.m. sharp in Amphitheatre 224 of the Library Building, Morisset Hall, 65 Hastey:
  - a) 9:00 - 9:30: introducing the staff and general information on the program.
  - b) 9:30 - 10:30: French placement test, to divide students into homogeneous groups of language ability (8 groups for the morning classes - maximum of 15 students per group; and 6 groups for the afternoon seminars - maximum of 20 students per group).
  - c) 10:30 - 11:00: the socio-cultural activity program for evenings and week-ends, introduced by the two monitors.
  - d) 11:00 - 11:30: registration for the course and for student card purposes (have a two dollar bill ready).
  - e) 11:30 - 12:00: first food allowance cheque of \$45.50 distributed.
2. Lunch time, free period.
3. First "class": 1:15 - 4:15
  - a) at 1:15, general assembly in Amphitheatre 224, where students will be called and assigned to their afternoon group with their teacher.
  - b) at 1:30, in the classroom with the teacher...
  - c) later on: tour of the campus with the teacher
4. Free period, from four to eight.
5. First social activity: from eight to eleven..., not to be missed! Meet your colleagues and the staff! French only is allowed! Dress is chic! Program is ... you'll see!

Vous allez bientôt participer à la huitième Ecole française de l'Université d'Ottawa, qui vous offre l'occasion d'une expérience inoubliable à la fois comme individu et comme Canadien(ne). Vous allez faire partie du programme intensif en langue seconde lequel, d'été en été, depuis 1969, a été mis au point avec minutie et avec enthousiasme; le programme a ainsi atteint un certain degré de perfection, si bien que les candidatures se font de plus en plus nombreuses chaque année. Mais comme nous tenons à garder un nombre limité d'inscriptions, toutes les candidatures ne peuvent plus être acceptées: nous voulons que chaque étudiant reste l'individu d'une "grande famille".

Nous vous offrons donc six semaines bien remplies qui passeront trop vite et qui seront à la fois exigeantes, enrichissantes et intensément humaines.

On y va?

Le directeur de l'Ecole française d'été 1976



Hubert Séguin

	LUNDI	MARDI	MERCREDI	JEUDI	VENDREDI	SAMEDI	DIMANCHE
1 <sup>ère</sup> semaine	5- Accueil Vin & Fromage Salon Bleu	6- Danse d'ouverture Ecoles: F & A Salon Bleu	7-	8-	9- Gilles Vigneault Camp Fortune	10- Journée sportive Lac Philippe	11-
2 <sup>e</sup> semaine	12- Cours de danses carrées	13- Souper Ecoles: F & A Cafétéria	14- Monique Miville- Deschênes Camp Fortune	15-	16- Soirée canadienne Ranch du Cheval Blanc	17-  Randonnée de nuit (équitation) Ecoles: F & A	18-
3 <sup>e</sup> semaine	19- Photos (Album-souvenir) C. Léveillé Camp Fortune	20- Danse des Raftsmen Ecoles: F & A	21-	22-	23- Rally Ecoles: A & F Renée Claude Camp Fortune	24- Pique-Nique Lac Beauchamp Ecoles: A & F	25-
4 <sup>e</sup> semaine	26-	27- Casino Ecoles: A & F Salon Bleu	28-	29- Opéra Centre National des Arts	30-   V O Y A G E A Q U E B E C	31-	1-
5 <sup>e</sup> semaine	2-	3- Danse du Mardi Gras Ecoles: A & F Salon Bleu	4- Les Troubadours Théâtre Odéon	5- Répétition générale (sketches)	6- Soirée de sketches Théâtre Odéon	7-	8-
6 <sup>e</sup> semaine	9-	10-	11- Soirée de clôture Ecoles: A & F Salon Bleu	12- Gala- Diaporama Salon Bleu			

SCHEDULE OF SOCIAL EVENTS

APPENDIX C

Mood Adjective Checklist

NAME: \_\_\_\_\_ DATE \_\_\_\_\_ NITE \_\_\_\_\_ REM \_\_\_\_\_

MOOD ADJECTIVE CHECK LIST

	AGGRESSION	ANXIETY	SURGENCY	SOCIAL AFFECTION	DEPRESSION	DISTRUST	QUIET	DETACHED
		jittery____	playful____			suspicious____	quiet____	detached__
	defiant____ angry____			warm-hearted____	sad____			
		fearful____	carefree____	affectionate____	regretful____			distant____
	rebellious____	clutched up____				skeptical____	placid____	remote____
			witty____	kindly____	sorry____	dubious____	still____	
TOTAL	____	____	____	____	____	____	____	____

Dream active \_\_\_\_\_  
 You active \_\_\_\_\_  
 Dream busy \_\_\_\_\_  
 How vivid \_\_\_\_\_  
 Sleep depth \_\_\_\_\_

Individual adjectives are scored as follows:  
 MUCH is scored as 3, LITTLE as 2, DON'T KNOW  
 as 1, and NO as 0. Factor scores are obtained  
 by summing the scores of the individual adjectives  
 in the factor.

APPENDIX D

Dream Content Scoring Sheet

## ANALYSE DE CONTENU

Juge:

Sujet:

Rêve:

Interactions sociales:

Aggression dirigée:

Amitié dirigée:

Sexualité dirigée:

Aggression reçue:

Amitié reçue:

Sexualité reçue:

Aggression neutre:

Amitié neutre:

Sexualité neutre:

Activités:Contenu verbal:

Physique:

rêveur seul: français: anglais:

Mouvement:

rêveur - autres: français: anglais:

Visuelle:

autre: français: anglais:

Auditive:

français fragmenté dans le rêve:

Cognitive:

français fragmenté dans le rapport:

Réussite-faillite:

réussite personnelle:

échec personnel:

réussite d'autrui:

échec d'autrui:

Destin:

bonne chance personnelle:

malchance personnelle:

bonne chance d'autrui:

malchance d'autrui:

Emotions:

colère:

confusion:

joie:

tristesse:

anxiété (1 à 5):

Participation:Dérèglement cognitif (1 à 5):

nulle:

PAS DE REVE:

passive:

PAS DE RAPPEL DE CONTENU:

active:

marquée:

APPENDIX E

REM % for Adaptation Nights 1 & 2

REM % for Adaptation Nights 1 and 2

Subjects	Control I			Experimental			Control II		
	Night 1	Night 2	$\bar{X}$	Night 1	Night 2	$\bar{X}$	Night 1	Night 2	$\bar{X}$
1	17.09	21.94	19.52	19.85	26.99	23.42	15.82	24.39	20.11
2	8.14	14.45	11.32	20.30	22.25	21.28	23.86	22.85	23.36
3	15.66	19.40	17.53	28.40	23.79	26.10	23.04	22.48	22.76
4	16.54	24.75	20.65	20.11	21.72	20.92	20.35	22.09	21.24

NOTE: REM % of adaptation nights during control I are rough approximations due to technical difficulties with electroencephalograph.

APPENDIX F

Examples of Dream Content with Verbal  
Communication Incorporations

Examples of Dream Content With  
Verbal Communication Incorporations

Example 1:

Subject 4, Experimental Session, Night 6, 1st REM, 1st Dream  
Collection

Experimenter (E): Was there anything going through your  
mind John?

Subject (S): 'Maintenant'? (pause)

E: Was there anything going through your mind?

S: Yes, there was a barbecue beside the canal, at the  
University. I can't remember why I was there.

E: What was that John?

S: There was a barbecue beside the University and I can't  
remember why I was there. I was doing different 'choses'...  
I was in a boat on the canal going to a barbecue. There  
were no people in it. I was the only participant. It  
wasn't a vivid dream... (pause)

E: You were in a boat on the canal?

S: Yes... I was talking English ... at the same time, I was  
sort of saying the same words in French. I was saying  
it in French too but you couldn't hear it, only I could  
hear it.

E: Anything else you can remember John?

S: No.

E: O.K., I'll give you the check list.

Example 2:

Subject 3, Experimental Session, Night 6, 1st REM, 1st Dream  
Collection.

E: Was there anything going through your mind?

S: Pardon?

E: Was there anything going through your mind?

S: 'Je ne sais pas la question'?

E: Are you awake John?

S: Yes

E: Do you remember any dreams?

S: Oui, I was. I was in a class and I was talking to you... and we were sort of happy ... a ... you know 'content'. There were other people there talking French too.

E: Yes!

S: 'Parle le français' ... you know.

E: Yes!

S: They were also listening to music ... 'écouter'.

E: Anything else John?

S: 'Oui'. There was alot of colors, the chairs and the surroundings were very vivid. (pause) We talked fast ... myself, John Lamb and others. We talked fast and we were going to talk more in order to learn more (pause) 'La petite classe' a little room on the campus to talk French and have easy access to the lectures and the classroom.

E: Anything else John?

S: I don't think so ... 'Je ne sais pas de l'autre maintenant'.

E: Any feelings involved?

S: Yes, there were, but they weren't very strong. It was a feeling of companionship ... you know, the kind of feeling you might have in a close knit group learning French. I felt good towards the group ...

E: Anything else John?

S: Not now ... probably when I finish my dream.

E: O.K., I'll give you the list John.

APPENDIX G

Mean Values of Pre and Post-Sleep MACL Scores  
and Mean Values of MACL Given After  
Each REM Awakening

## Mean Values of Pre and Post-Sleep MACL Scores

Subject	Pre-Sleep			Post-Sleep		
	Control I	Experi- mental	Control II	Control I	Experi- mental	Control II
Aggression						
1	.00	.33	.00	.00	.83	.00
2	.33	.00	.00	.33	.00	.00
3	1.75	.00	.00	1.50	.00	.00
4	.00	.33	.33	.00	.00	.33
Anxiety						
1	.00	.00	.33	.00	.17	.17
2	.00	.00	1.00	.00	.33	.33
3	1.25	.33	.67	.50	.33	.33
4	.50	.00	.33	.00	.33	.00
Surgency						
1	1.67	4.83	3.00	1.50	.50	3.00
2	.67	.67	.00	.33	.00	.67
3	2.00	2.33	4.67	3.00	2.67	4.67
4	4.00	2.67	2.00	2.75	1.00	.83
Social Affection						
1	2.83	2.00	2.50	3.67	.00	3.00
2	1.50	1.67	1.67	1.00	1.33	2.33
3	4.25	6.67	6.83	4.50	5.50	6.67
4	3.75	3.17	1.50	2.75	2.17	1.50
Depression						
1	1.67	.33	.33	.50	.00	.17
2	.00	2.50	2.00	2.17	1.33	1.00
3	.75	3.00	.67	1.75	1.33	1.33
4	.50	.83	.17	.00	.00	.00

Subject	Pre-Sleep			Post-Sleep		
	Control I	Experi- mental	Control II	Control I	Experi- mental	Control II
Distrust						
1	.00	.00	.00	.00	.50	.00
2	1.00	.67	2.00	.50	.00	1.67
3	.75	1.00	1.33	2.25	.33	1.00
4	.00	.00	.50	.00	.00	.00
Quiet						
1	6.00	.17	3.17	5.17	5.00	1.67
2	7.17	5.83	6.33	5.00	5.33	5.67
3	3.50	5.17	5.00	4.00	4.17	5.17
4	.00	.17	.50	.00	.00	.67
Detached						
1	3.66	2.00	1.00	4.67	3.83	.00
2	.00	.33	.00	.00	.00	.00
3	1.75	2.00	1.00	3.00	2.50	1.17
4	.00	.17	.50	.00	.00	.67

## Mean Values of MACL Given After Each REM Awakening

Subject	Control I & II	Experimental	D (Exp-Cont)
Aggression			
1	.72	1.40	.68
2	.22	.00	-.22
3	1.63	.65	-.98
4	2.10	1.90	-.20
Anxiety			
1	.65	.10	-.55
2	.17	.00	-.17
3	.85	.90	.05
4	.59	1.50	.91
Surgency			
1	3.30	1.82	-1.48
2	1.09	.00	-1.09
3	4.52	2.35	-2.17
4	2.22	1.57	-.65
Social Affection			
1	1.04	.90	-.14
2	1.11	.60	-.51
3	6.64	4.60	-2.04
4	1.68	1.34	-.34
Depression			
1	1.05	.20	-.85
2	.88	1.40	.52
3	1.00	1.75	.75
4	.53	1.25	.72

Subject	Control I & II	Experimental	D (Exp-Cont)
Distrust			
1	.79	.37	- .42
2	2.00	.40	-1.60
3	1.70	1.60	- .10
4	1.03	1.75	.72
Quiet			
1	2.10	3.05	.95
2	3.21	6.20	2.99
3	3.97	3.45	- .52
4	1.72	.92	- .80
Detached			
1	2.84	.74	-2.10
2	.35	.00	- .35
3	3.44	1.70	-1.74
4	1.34	1.59	.25