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The Impact of Probable Depression on Daily Performance in College Students: "Morningness" Versus "Eveningness"

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THE IMPACT OF PROBABLE DEPRESSION ON DAILY PERFORMANCE IN COLLEGE STUDENTS: "MORNINGNESS" VERSUS "EVENINGNESS"

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This thesis, submitted by Iwona Chelminski in partial fulfillment of the requirements for the degree of Master of Arts from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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ABSTRACT

In the present study responses on the Beck Depression Inventory (BDI), Geriatric Depression Scale-Short Form (GDS-SF), and Center for Epidemiological Studies Depression (CESD) were compared in 1,617 college undergraduates. Also, the "eveningness-morningness" dimension, as measured by the Horne and Ostberg questionnaire (H&O), was examined among the "probably" depressed student population. In addition, the impact of the "probable" depression on performance on various memory tests at different times of day was investigated. Finally, performance of the "probably" depressed students was compared with performance of the nondepressed students. In the first part of the study 1,617 undergraduates were surveyed and 136 completed the second part. A series of mixed analyses of variance revealed that scores on the 3 depression scales were significantly correlated (correlation for BDI and GDS-SF r=.763, for BDI and CESD r=.778, for GDS-SF and CESD r=.726). Further, there were significant, negative correlations between the Horne and Ostberg questionnaire scores and the responses on the 3 depression scales (for BDI r=-.174, GDS-SF r=-.182, CESD r=.-176). Also, the "probable" depression was related to performance on various memory tests among college students. The analysis of the number of words correctly recalled on the California Verbal Learning Test revealed a significant main effect of group, $F(1,130)=12.51$, $p<.001$. The overall mean for nondepressed was $M=11.48$, for "probably" depressed $M=10.36$. Also, the analysis of the performance on the WAIS-R Digit Symbol test revealed a main effect of group, $F(1,129)=20.54$, $p<.001$. The overall mean for nondepressed was $M=74.70$, for "probably" depressed $M=67.95$. Discrepancies of the present results with other research findings in this area are discussed. In addition, conclusions and recommendations for future research are provided.

CHAPTER I

INTRODUCTION

In the last two decades, there has been an increase in information concerning the relationship between mood, behavior, and 24-hour circadian rhythms in people. Current knowledge of mood disorders supports the conclusion that these disorders do not simply reflect alterations in mood, but also entail dysfunction in many regulatory systems. Most biological parameters in people are on a 24-hour clock. This clock is controlled by a pacemaker in the brain. Duchek, Balota and Ferraro (1994) argued that the central timing mechanism is a function of the integrity of the cerebellum. However, they found further evidence that the basal ganglia is also a part of the neural circuit involved in timing. Thus, they concluded that the exact neural subsystems involved in timing are not entirely clear.

Among the biological disturbances associated with endogenous depression, circadian rhythm abnormalities have recently emerged as an area of intensive research. An abnormal circadian temporal order and a reduction of amplitude of circadian rhythms have been reported for various biological parameters in depression. Disruption of the circadian features of clinical parameters, such as rapid-eye movement sleep, body temperature, thyroid stimulating hormone (TSH), or plasma cortisol appear as the essential biological characteristics of primary depression and related affective disorders.

Nearly all clinically depressed patients demonstrate a change in their patterns of sleep continuity. Sleep disturbances have been considered as central symptoms of depression for as long as this disorder has been recognized. (Detre, Himmelhoch, Swartzburg, Anderson, Byck, & Kupfer, 1972; Garvey, Mungas, & Tollefson, 1984; Gillin & Borbely, 1985; Kupfer, Himmelhoch, Swartzburg, Anderson, Byck, & Detre, 1972; Reynolds, Gillin, & Kupfer, 1987; Reynolds & Kupfer, 1987; Rosenthal, Sack, Gilin, Lewy, Goodwin, Davenport, Mueller, Newsome, & Wehr, 1984; Taub, Hawkins, & Van de Castle, 1978; Wehr, Sack, & Rosenthal, 1987). The pervasiveness of sleep disturbances in all affective disorders suggests that, perhaps, they are not just symptomatic but may be instrumental in the pathology of the disorder.

The pathological changes of sleep in depression include a prolonged sleep latency, decreased Rapid Eye Movement (REM) sleep latency, increased REM sleep density, prolonged duration of the first episode of REM sleep, decreased slow wave sleep (SWS), and decreased sleep maintenance. Several of those symptoms persist well into a period of clinical remission, yet it is unknown whether these abnormalities precede the development of depression and thus, can be considered trait markers.

The abnormal biochemical and physiological circadian rhythms in some depressed patients may be normalized by manipulating the timing of light during the day, advancing or delaying the sleep phase, or by administering psychoactive, antidepressant drugs that may have the effect of returning circadian rhythms toward normal. The relationship between depression and sleep is very intriguing. On one hand, sleep disturbances are the most common symptoms of depression. Moreover, Wehr and Sack (1987), suggest that mania may be caused by a loss of sleep, which alters circadian rhythms. On the other hand, sleep deprivation can induce a distinct, although very short, remission of the depressive symptoms (Kupfer et al., 1988). It is puzzling that the denial of apparently impaired sleep processes has an antidepressant effect. Borbely and Wirtz-Justice (1982), proposed a hypothesis based on assumption that a sleep-dependent process of sleep regulation (process S) is deficient in depression. The antidepressant effect of sleep deprivation is presumably caused by the increase in the level of process S during prolonged waking.

Several investigators (Kripke, Mullaney, Atkinson, Huey, & Hubbard, 1979; Papousek, 1975; Wehr, Wirz-Justice, Goodwin, Duncan, & Gillin, 1979) proposed a "phase-advance hypothesis" for affective disorders. They hypothesized that depression could result from circadian rhythms that were abnormally advanced (shifted earlier) with respect to real time and to sleep. There are, however, depressed patients who display phase delays. Lewy, Sack, and Singer (1984) and Lewy, Sack, and Singer (1985), proposed that circadian rhythms can be either abnormally phase-advanced or abnormally phase-delayed. Patients with major depression tend to display phase advances and winter depressives tend to display phase delays. Kripke (1983) suggested that the trigger for depression might not be a single oscillator phase, but, rather, an abnormal phase-angle relationship between two circadian oscillators.

Many common biological variables show a definite periodicity with a cycle length of 24 hours. These variables include body temperature, heart rate, blood pressure, and hormone levels. Psychological and behavioral variables such as mood, alertness, drowsiness, and task performance also demonstrate circadian effects. Although these rhythms tend to be fairly consistent across individuals, individual differences in circadian rhythms have been observed. One of the most important aspects of individual differences in circadian rhythms has been identified as a degree of "morningness" and "eveningness." This dichotomy dates from the work of O'Shea (1900). It has long been recognized that some people consistently prefer day activity while others prefer night activity (Freeman & Hovland, 1934, Kleitman, 1939). These diurnal types are known to differ in sleep-wake patterns and biological rhythms (e.g., body temperature) as well as preferences, affect, and behaviors (Kerkhof, 1985). Researchers who were interested in studying "morningness" and "eveningness" have developed various self-report questionnaires to measure these preferences. The most often used scales include questionnaires proposed by Horne and Ostberg (1976), Folkard, Monk, and Lobban (1979), and Torsvall and Akerstedt (1980). Smith, Reilly, and Midkiff (1989), found that the Torsvall and Akerstedt (1980), 7-item scale and the Folkard, Monk, and Lobban (1979), 19-item scale has low internal consistency, reliability and marginally adequate inter-item psychometric properties. For these reasons the Horne and Ostberg questionnaire (1976), became the most widely accepted tool in the scientific community for measuring "eveningness" and "morningness." It has adequate inter-item measurement properties, and strong relationships with external criteria (Smith et al., 1989).

There is much evidence supporting the association found between age and "eveningness" and "morningness." Typically, the older the subject, the more pronounced is the tendency to have a "morningness" personality (May, Hasher, & Stoltzfus, 1993; Monk, Reynolds, & Buysse, 1991; Mecacci, Zani, Rocchetti, & Lucioli, 1986). However, it is not known whether this phenomenon is due to natural preferences or to work schedule. Mecacci and Zani (1983), who compared sleep-waking diary data of morning and evening types in student and worker samples, concluded that the acquisition of a regular job (from 9:00 a.m. to 5:00 p.m.), seems to induce a change in sleep-wake behavior. As a rule, the elderly have to adjust themselves to the demands of working in the morning and early afternoon, whereas students are more likely to be able to adapt their study schedule to their natural preferences. Since students usually are not forced to develop morning activity, some concluded, that in cases where they do show "morningness" preferences it is endogenously determined (Adan and Almirall, 1991; Tankova and Buela-Casal, 1994).

Ishihara, Honma, and Miyake (1990), administered a children's version of the Horne and Ostberg questionnaire to a large (approximately 1700), sample of students of a primary school and a junior high school in Japan. They found that scores significantly changed towards a preference for "eveningness" over advancing grades, in particular from Grade 4 of primary school to the first grade of junior high school. They also pointed out that the mean score of junior high school students (males and females) did not differ from the scores of the female university students. Researchers found that typically, people have a tendency to display "eveningness" in their teens and young adulthood but at about age 50 they move toward "morningness." Tankova and Buela-Casal (1994) speculated that the plausible explanation for the tendency to exhibit "morningness" characteristics in aged people may be due to the fact that the neuronal activity of the hypothalamic body clock is reduced with age, especially after age 50. As a consequence the dependence on socio-environmental synchronizers, the majority of which have morning pattern, become stronger. However, the question regarding whether "eveningness-morningness" is a relatively enduring, stable characteristic, determined endogenously, remains unanswered, and longitudinal studies are needed with work schedules being controlled.

There have been many studies comparing the evening type and the morning type on various characteristics (Anderson, Petros, Beckwith, Mitchell, & Fritz, 1991; Casal, Caballo, & Cueto, 1990; Colquhoun & Folkard, 1978; Drennan, Klauber, Kripke, & Goyette, 1991; Horne & Ostberg, 1976; Horne, Brass, & Pettitt, 1980; Mitchell & Redman, 1993; Ostberg, 1973a, 1973b;1977; Vidacek, Kaliterna, Radoseurd-Vidacek, & Folkard, 1988). Typically, evening types who display delayed circadian rhythm, wake up later than morning types. In evening type individuals the body temperature rises steadily throughout the day, reaching a pronounced peak in the middle evening and in some cases, late at night. The morning types show the opposite pattern and they tend to show a steeper rise of the body temperature in the morning, which levels off to a less pronounced but significantly earlier peak than for the evening types. Furthermore, the evening types take longer to fall asleep and the sleep phase IV appears much later (Casal, 1984).

There also appear to be some personality differences between morning and evening types, and one of the most commonly cited differences is a positive correlation between level of "eveningness" and a degree of extraversion (Colquohoun, 1982; Eysenck, 1982; Folkard & Monk, 1983; Kirkaldy, 1984; Mecacci et al., 1986; Wilson, 1990). Extraverts tend to be evening types and introverts tend toward "morningness." In addition, Levy (1985), found evening types more pessimistic than morning types. Tankova and Buela-Casal (1994), in their review of studies that have examined the relationship between circadian typology and other individual difference variables, concluded that neurotism and psychotism are not associated with performance on "morningness-eveningness" scales. There are, however, some contradictory results. Several studies have found correlations between these two dimensions suggesting that "eveningness" is related to higher neurotism. However, Mecacci et al., (1986) found that morning types had significantly higher scores on a neurotism scale and evening types had significantly higher scores on a psychotism scale. Later, Wilson (1990) obtained the same interaction between psychotism and "eveningness." Neubauer (1992) suggests that these inconsistencies might be due to the properties of the questionnaires because when the revised version of the Horne and Ostberg questionnaire was used (Adan & Almirall, 1991), this phenomenon disappeared completely.

A number of studies that analyzed the relationships between different measures of performance in morning and evening types have been conducted (Anderson et al., 1991; Casal et al., 1990; Horne et al., 1980; May et al., 1993; Petros, Beckwith, & Anderson, 1990). Generally, performance on various cognitive tasks in evening types improves throughout the day, whereas the performance of morning types decreases across time of day. The results demonstrated that time of day influences performance in adults, and the pattern of these effects depends on whether a person is a morning or an evening type. The typical interpretation of these differences suggests that different patterns of physiological arousal may play a role. The morning types show the maximum level of arousal in the morning and a minimum level late in the evening. Evening types show a minimum level in the morning and a maximum level late in the evening.

Recently, May et al., (1993), became interested in how the time of day affects the memory performance of young and older adults who are either evening or morning types. May at al. (1993) compared memory performance of older adults who were the morning types exclusively, with young adults who were the evening types. The subjects were tested in the morning or in the late afternoon. Significant differences were found in the late afternoon, when younger but not older subjects were at their optimal times. However, no age differences in memory performance were found in the morning, when older but not younger adults were at their peak period. It appears that a synchrony between optimal performance periods and the time at which testing is conducted may be a critical variable in determining group differences in intellectual performance or in cognitive impairments like those observed in the depressed patients.

As early as 1955, Mayer-Gross et al. noted that, improvement of depressive symptoms in patients usually occurs towards evening. Particularly, the retardation and depressive mood show a change for the better. In the morning, however, patients wake into a characteristic gloomy mood. According to more recent research findings, about 50-75% of depressed patients show diurnality (for review see Reinik, Bouhuys, Wirz-Justice, & Hoofdakker, 1990). In these populations, 66-90% of the patients are evening types and 10-34% are morning types. Drennan et al., (1991) found that depressed patients reported significantly more "eveningness" than age- and sex-matched controls. It is possible that the increased "eveningness" in depressed patients is not simply a characteristic of the depressive state, but rather reflects a premorbid trait, or vulnerability. Consequently, one might speculate that to be a morning type might be protective against depression, whereas "eveningness" might cause increased vulnerability.

Weitzman, Czeisler, and Coleman (1981) describe a new sleep disorder, the Delayed Sleep Phase Syndrome (DSPS). Some of the complains of those who suffer from DSPS are inability to fall asleep and wake up at an early time and poor morning alertness (7:00-9:00 am). On the "morningness-eveningness" scale, based on the Horne and Ostberg questionnaire, DSPS patients scored as extreme evening types. They also show prolonged sleep latency, decreased slow wave sleep (SWS), and decreased sleep efficiency (frequent awakening during sleep), which is similar to the depressed patients. Some researchers (Joseph-Vanderpool, Kelly, Schulz, Alen, Souetre, & Rosenthal (1989), report success in treating DSPS patients with bright light therapy (as with SAD patients), and others (Alvarez, Dahlitz, Vignau, & Parkes (1992) with the drug melatonin.

Seasonal affective disorder (SAD) was originally conceptualized as relating to seasonal rhythms, and was treated with bright-light exposure therapy to extend dawn and dusk (Lewy, Kern, Rosenthal, & Wehr, 1982). Lewy et al. suggested that bright light therapy may be effective in its treatment because some patients may have an advanced or delayed circadian rhythm as possibly indicated by delayed or advanced melatonin secretion. However, Lewy and others (Wehr, Jacobsen, Sack, Arendt, Tamarkin, & Rosenthal, 1986) no longer think that extending dawn and dusk artificially is critical. Rather, they think that this disorder relates more to circadian rhythms than to seasonal rhythms (Lewy, Sack, Miller, & Hoban, 1987). Specifically, they hypothesized that most winter time depressives have abnormally delayed circadian rhythms. Moreover, the SAD patients exhibited more "eveningness" than a control group (Rosenthal & Blehar, 1989).

Zetkin, Potkin, and Urbanchek (1987), suggest that the chemical melatonin may be a useful neuroendocrine indicator of affective disorders. It has been reported to promote internal and external synchronization in animals and in humans. Melatonin is a sensitive marker for biological rhythms and provides a link between the external environment's light and dark cycles and the body's internal neurohormonal regulations. Released during the night, melatonin reflects the presence of daily and seasonal rhythms of light exposure and may be abnormal in seasonal affective disorders. Rao and Mager (1987), found that the dramatic reduction of the nocturnal rise of melatonin observed in depression may alter the coupling processes between the pineal gland and other endocrine functions, thus promoting internal dissociation between different circadian rhythms. Manipulations of these coupling processes may be beneficial for depression. Tricyclics have been shown to increase the nocturnal secretion of melatonin in depressed patients. Moreover, the pharmacological stimulation of the nocturnal secretion of melatonin has been shown to have antidepressant effects (Souetre, Slavati, Belugou, Robert, Brunet, & Darcourt, 1987).

Steiner et al., (1987), asked whether there is a biochemical defect in depressives that causes a phase shift and a change in circadian rhythms of melatonin in the retina. This phase shift, then alters the sensitivity of the retina to light, which in turn desynchronizes all other biological rhythms. The retina in humans is the only photoreceptor for circadian entrainment. Melatonin has been implicated in regulation of the sensitivity of the retina to light. It is widely known that depressed patients exhibit abnormalities in circulating melatonin. Steiner et al., suggest that depression, which is a disease associated with neurotransmitter and hormonal changes (Pfhol, Sherman, Schlechte, & Stone, 1985), may have its counterpart in the retina. They hypothesized that, perhaps, abnormal retinal sensitivity to light precedes the depressive phenomenology. Changes in retinal sensitivity to light could result from abnormal melatonin levels. These investigators proposed that the primary defect in depression may be a change in retinal function and that behavioral concomitants of this disorder are secondary events.

Borbely and Wirtz-Justice (1982) argued that the persistence of some sleep alterations during remission of a depressive episode suggests either that the sleep abnormalities take longer to normalize than the clinical symptoms, or that these abnormalities manifest a basic disease process even though the symptoms are not present. The questions for future study should be, whether the disturbances in the structure of circadian processes trigger episodes of affective illness and whether the disturbed circadian rhythms are a symptom of some primary CNS dysregulation predisposing an individual to the affective illness. To restore a normal relationships between the circadian system of the depressed patients and the temporal structure of their environment may be a basic mechanism involved in the treatment of depression.

The "eveningness-morningness" continuum is thought to reflect an underlying trend toward advanced or delayed phase adjustment in a variety of circadian systems. In summary, there are many common aspects of "eveningness-morningness" dimension and depressiveness such as: circadian rhythm abnormalities (arousal and performance level, body temperature, melatonin levels), sleep disturbances (increased latency, decreased SWS, decreased sleep efficiency), effective treatment with bright light (in the evening types resulting in the advance of late sleep onset, and in the SAD patients resulting in alleviation of depressive symptoms). Furthermore, some studies have found that depressed patients reported more "eveningness" than age- and sex-matched controls (Drennan et al., 1991; Reinik et al., 1990).

The standard treatments for depression (lithium, MAO inhibitors, tricyclic antidepressants, and a new generation of drugs like Prozac) may act by affecting biological circadian rhythms in man. This study may provide support to the emergence of a new field, "circadian pharmacology." This field would aid our understanding of the mode of action of our current pharmacological treatments for depression, and may be important in the development of new pharmacological agents for this disorder. The investigation of the altered circadian rhythms in depressed could provide insight into the underlying biological causes of affective illness.

Hypotheses

The present study was designed to address three issues. First, performance on the Beck Depression Inventory (BDI), Geriatric Depression Scale-Short Form (GDS-SF), and Center for Epidemiological Studies Depression (CESD) was compared. Second, the "eveningness-morningness" dimension, as measured by the Horne and Ostberg questionnaire, was examined among the "probably" depressed student population. Third, an impact of the "probable" depression on performance on various memory tests at different times of day was investigated.

The following hypotheses were made a priori:

1. High and significant correlations between BDI, GDS-SF and CESD are expected (predicted r=.70 or higher).
2. High, negative and significant correlations between the Horne and Ostberg questionnaire, BDI, GDS-SF, and CESD are expected (predicted r=-.70 or higher).
3. A significantly higher number of evening types than the morning types is expected among the subjects identified as "probably" depressed.
4. Sleep quality, as measured by the Pittsburgh Sleep Quality Inventory (PSQI), is expected to be significantly different for the evening and the morning types. The evening types are expected to obtain significantly higher scores which indicate a worse sleep quality.
5. In analysis of performance on memory tests a significant type by time interaction is expected to be found. In the evening, the evening type subjects are expected to perform significantly better than the morning types. Consequently, in the morning, the morning type subjects are expected to perform significantly better than the evening types.

CHAPTER II

METHOD

Subjects

1,617 students, 1,041 females and 576 males currently enrolled at the University of North Dakota, participated in the first part of the study. Those who had high scores on 2 or 3 depression scales (score of 10-63 on the Beck Depression Inventory-BDI, score of 6-15 on the Geriatric Depression Scale-GDS, and score of 16-60 on the Center for Epidemiological Studies Depression Scale-CESD) were defined as "probably" depressed. Subjects who were "probably" depressed and were either an evening or morning type (Horne & Ostberg questionnaire score of 0-41 for an evening type, 59-86 for a morning type), were contacted again and were asked to participate in the second part of the study within the next two weeks. 54 females and 24 males agreed to come to be tested in the second part. All subjects volunteered to participate in the study and received an extra credit hour for each part of the study in beginning-level psychology classes.

Materials

The following, paper-and-pencil instruments were administered to all subjects:

1. Beck Depression Inventory (BDI),
2. Geriatric Depression Scale-Short Form, 15-item, (GDS-SF),
3. Center for Epidemiological Studies Depression Scale (CESD),
4. State-Trait Anxiety Inventory-the Trait scale (STAI),
5. Horne and Ostberg questionnaire (H & O),

In the second part of the study the following instruments were used:

1. California Verbal Learning Test-(CVLT)
2. Vocabulary subtest of the Wechsler Adult Intelligence Scale-Revised (WAIS-R),
3. Digit Span subtest of the Wechsler Adult Intelligence Scale-Revised (WAIS-R),
4. Digit Symbol subtest of the Wechsler Adult Intelligence Scale-Revised (WAIS-R),
5. Pittsburgh Sleep Quality Index (PSQI),
6. State-Trait Anxiety Inventory-the State scale (STAI),

The BDI is a 21-item, self-report measure of depression developed by Beck, Ward, Mendelson, and Erlbaugh (1961), which has been widely used in clinical and research settings. It measures affective, behavioral, cognitive, and somatic symptoms of depression. Each item consists of four self-evaluative statements, with intensity scores that range from 0 to 3. A high construct validity of this instrument has been reported as well as high correlation with other depression scales (Beck & Beamesderfer, 1974). The "probably" depressed students were selected on basis of a BDI score greater than nine(10-63).

The GDS-SF is a 15-item instrument employing a yes/no format developed by Brink and his associates (Brink, Yesavage, Lum, Heersema, Adey, & Rose, 1982) for use with an older population. It excludes items that are confounded with normal aging and diseases associated with older ages and assesses primarily psychological components of depression. Validity with respect to depression late in life compares favorably with the Hamilton, Beck, and Zung depression scales (Brink et al., 1982; Hyer & Blount, 1984). There are some studies concluding that the GDS-SF is sufficiently reliable to use with young adults (Best, Davis, Morton, & Romeis, 1984; Brannan, Pignatiello, & Camp, 1986; Brink & Niemeyer, 1992; Ferraro & Chelminski, in press; Rule, Harvey, & Dobbs, 1989; Tamkin, Heyer, & Carson, 1986). The GDS-SF has been shown to be a quick, self-report, screening measure for "probable" depression, and as reliable as the BDI. The "probably" depressed students were selected on basis of a GDS score greater than five (6-15).

The CESD (Radloff & Teri, 1986) contains 20 items covering a broad range of depressive symptomatology (affective, cognitive, behavioral, somatic, and interpersonal) as well as an ordinal response format based on frequency of occurrence of individual depressive symptoms. The scale has been used with a wide range of ages and populations. The correlation between scores on CESD and GDS was 0.66 (Brink & Niemeyer, 1992). The "probably" depressed students were selected on the basis of a CESD-total score greater than fifteen.

The STAI (Spielberger, Gorsuch, and Lushene, 1967) assesses separate dimensions of state and trait anxiety. The State scale is a self-report measure that has 20 items rated on 4-point intensity scales. Ten of the items are positively worded and 10 items are negatively worded. The Trait scale also has 20 items rated on 4-point intensity scales. Nine of the items are positively worded, and 11 items are negatively worded. Both, STAI State and Trait scales were developed as unidimensional measures. Spielberger (1966), defined state anxiety as a transitory emotional response involving unpleasant feelings of tension and apprehensive thoughts. Trait anxiety, on the other hand, was defined as a personality trait referring to individual differences in the likelihood that a person would experience state anxiety in a stressful situation.

The Horne and Ostberg (H&O) questionnaire (1976), consists of 19 items pertaining to habitual rising and bed times, preferred times of physical and mental performance, and subjective alertness after rising and before going to bed. The H&O yields scores on a single scale of "morningness" vs. "eveningness" ranging from 16 to 86. Higher scores suggest greater "morningness." Lower scores indicate greater "eveningness," i.e., a preference to sleep later, and for evening activities.

Definitely Morning Type	70-86
Moderately Morning Type	59-69
Neither Type	42-58
Definitely Evening Type	16-30
Moderately Evening Type	31-41

The H&O scale has adequate interitem measurement properties and relationships with external criteria (oral temperature measurements over the course of the day and sleep parameters), are fairly strong (Smith, Reilly, & Midkiff, 1989).

The CVLT (Delis, Kramer, Kaplan, & Oberg, 1987), is a neuropsychological assessment instrument used to assess multiple parameters of verbal learning and memory. It differs from traditional clinical memory tests by assessing not only single achievement scores of the number of items passed but also assesses the strategies, processes, and errors examinees display in remembering verbal material. In addition to assessing levels of recall and recognition, the CVLT quantifies such variables as semantic clustering (the most effective learning strategy) in recall, learning rate across trials, recall consistency, vulnerability to proactive and retroactive interference, retention of information over short and long delays, error types, and signal detection parameters (discriminability and response bias) in recognition memory (Delis, Massman, Kaplan, McKee, Kramer, & Gettman, 1991). The CVLT consists of two lists: List A, which is presented for five learning trials, and List B, which is presented once following the List A learning trials. Short-delay recall of List A is assessed after List B is presented. Long-delay recall and recognition of List A are assessed after an additional 20 minute delay. Both List A and List B are made up of four words each from four semantic categories. Two of the List B categories are the same as categories on List A and are referred to as "shared" categories. The other two List B categories are different and are referred to as "nonshared" categories. Factor-analytic studies of the CVLT have found that its expanded scoring system yields a number of theoretically meaningful, component factors beyond the single learning factor found when only correct recall is scored (Delis, Freeland, Kramer, & Kaplan, 1988). When the two alternate forms of CVLT were administered, sixteen of the CVLT variables resulted in significant alternate form reliability coefficients. The coefficients for the traditional recall measures of the CVLT were particularly robust and higher than those reported for other, commonly used clinical memory tests (Delis et. al., 1991).

In his review of the psychometric characteristics of the CVLT, Elwood (1995), argues that the CVLT is limited by its poor standardization and inflated norms. Furthermore, he claims that the validity is also limited because CVLT uses multiple trial to measure constructs that are based on single-trial paradigms. However, Elwood concludes that if these limitations are recognized the CVLT can still be very useful in clinical assessment of verbal learning and memory.

Otto, Bruder, Fava, Delis, Quitkin, & Rosenbaum, (1994), provided norms for depressed subjects for the CVLT. According to their findings, mean CVLT memory scores for depressed were generally between 1/2-1 standard deviation below age- and sex-corrected norms for nondepressed populations. Severity of depression in the patients was not associated with memory performance.

The WAIS-R vocabulary subtest (Wechsler, 1981) requires subjects to define number of words of increasing difficulty. This subtest is widely known to be an excellent estimate of verbally based intellectual functions, and it highly correlates with verbal and overall intelligence. Higher scores indicate higher levels of vocabulary ability.

The Digit Span subtest of the WAIS-R is a measure of short-term auditory memory and attention. Digits Forward involves rote learning and memory, whereas Digits Backward requires considerably greater transformation of the stimulus input prior to recall. Thus, Digits Forward appears to involve primarily sequential processing, whereas Digits Backward appears to involve both planning ability and sequential processing. High scores on Digits Backward may indicate flexibility, good tolerance for stress, and excellent concentration (Sattler, 1992).

The Digit Symbol subtest of the WAIS-R can be conceptualized as an information-processing task involving the discrimination and memory of visual pattern symbols. This test taps the ability to learn an unfamiliar task and involves speed and accuracy of visual-motor coordination, attentional skills, short-term memory, cognitive flexibility (in shifting rapidly from one pair to another), and, possibly motivation. The subtest also involves speed of mental operation (psychomotor speed), and to some extent, visual acuity (Sattler, 1992).

The PSQI (Buysse, Reynolds, Monk, Berman & Kupfer, 1989), assesses sleep quality during the previous month. It consists of 19 self-rated questions that assess a wide variety of factors relating to sleep quality. These 19 items are grouped into seven component scores, each weighted equally on a 0-3 scale. The seven component scores are then summed to yield a global PSQI score, which has a range of 0-21. The higher scores indicate worse sleep quality. The seven components are standardized versions of areas routinely assessed in clinical interviews of patients with sleep/wake complaints. They are subjective measures of sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Buysse et. al., (1989) and Buysse, Reynolds, Monk, Hoch, Yeager, & Kupfer (1991), found that the PSQI discriminated groups of healthy middle-aged subjects, depressed patients and sleep-disorder patients. The instrument had good internal consistency and test-retest reliability, and its validity was supported by polysomnographic results.

Procedure

During the multiple testing sessions, subjects were gathered in a classroom and were given a packet of 5 instruments that were put together in 12 different pseudo-random orders. The packet included the BDI, GDS, CESD, STAI and Horne & Ostberg questionnaire. After agreeing to participate and signing an informed consent form the students completed all the instruments. The entire screening procedure lasted approximately 20 minutes. All of those who were found to be "probably" depressed (high scores on 2 or 3 depression scales) and were either an evening or morning type were contacted again and they were asked to participate in the second part of the study within the next two weeks.

At this second session subjects were tested individually. The subjects were randomly assigned to one of the six conditions-"evening type, 9:00 a.m.", "evening type, 2:00 p.m.", "evening type, 8:00 p.m.", "morning type , 9:00 a.m.", "morning type, 2:00 p.m.", "morning type, 8:00 p.m.". This individual testing sessions lasted approximately 45 minutes. First, a subject completed the vocabulary subtest of WAIS-R, then the first part of the CVLT was administered. During the 20 minutes of retention time the subject completed the PSQI, STAI-(State scale), and the Digit Span and the Digit Symbol subtests of WAIS-R. Following a 20 minute interval the subject was administered the second part of CVLT. Subjects' responses from the CVLT were recorded on audio tape recorder and later, after the testing session, they were transferred to subjects' record sheets.

CHAPTER III

RESULTS

Data analysis was conducted in two parts, using SPSS for Windows (1994). In the first part, the results from the initial phase of the study were analyzed (performance on the three depression scales, H & O questionnaire, and STAI the Trait scale). Mainly, correlational methods were used. The second part of the analysis examined the results obtained from subjects who participated in the second phase of the study (individual testing on various memory tasks). Again, correlational methods were employed as well as mixed analysis of variance and covariance.

Part 1

A total of 1,617 students participated in the first part of the study. There were 576 males (35.6%) and 1,041 females (64.4%). The age range was 18-53. The median and the mode were 19. Table 1 presents number of subjects as a function of the BDI, GDS, and CESD scores, where scores are either low or high (high scores are 10-63 on BDI, 6-15 on GDS-SF, and 16-60 on CESD)

The performance on GDS-SF was most consistent with national trends for "probable" depression within this age range. A number of "probably" depressed subjects detected by

CESD seems too high for this age range according to the norms (Greenberg, Stiglin, Finkelstein, & Berndt, 1993). A possible explanation, which involves analysis of the four components of CESD, will be suggested in the discussion section.

Table 1

Number of Subjects Tested as a Function of BDI, GDS, and CESD Scores

	Number and percent of subjects	
Depression scales	Low scores	High scores
Beck Depression Inventory (BDI)	1,251 (77.37%)	366 (22.63%)
Geriatric Depression Scale-SF (GDS-SF)	1,402 (86.70%)	215 (13.30%)
Center Epidemiological Studies Depression Scale (CESD)	1,060 (65.55%)	557 (34.45%)

According to the H & O questionnaire, out of the 1,617 subjects, 1,009 were the neither type (62.4%), 135 subjects were the morning type (8.3%) and 473 subjects were the evening type (29.3%). Table 2 presents the number of males and females as a function of H & O typology, where the evening type is represented by a score of 0-41, the neither type is represented by a score of 42-58, and the morning type is represented by a score of 59-86.

To examine the relationship between gender and typology a Chi-Square test was performed. The results indicate that the scores on the "morningness-eveningness" scale are not independent of the sex of the subjects, $\chi^2=7.05$, $p<.05$. This finding is not consistent with the findings reported in the literature (for review see Tankova and Buela-Casal, 1994). Possible explanations for this discrepancy will be presented in the discussion of the results.

Table 2

Number of Males and Females as a Function of H & Ostberg Typology

Type	Neither		Morning		Evening	
Gender	M	F	M	F	M	F
Total	367	642	34	101	175	298
Percent	63.7	61.7	5.9	9.7	30.4	28.6

A frequency of the three types among the subjects who scored high on the three depression scales is presented in Table 3. As can be seen, the majority of the "probably" depressed student population consisted of the <u>neither</u> and <u>evening</u> types, while the morning types represented only a small portion of that population (6.03% on average).

Table 3

Number of Subjects Across the Three Types as a Function of the High Scores on the Depression Scales

	High Scores on Depression Scales		
Type	BDI	GDS	CESD
Neither	207 (56.6%)	115 (53.5%)	318 (57%)
Morning	21 (5.7%)	13 (6%)	35 (6.4%)
Evening	138 (37.7%)	87 (40.5%)	204 (36.6%)

To examine the relationships between the three depression scales correlational methods were employed, and the resulting correlation matrix is presented in Table 4.

Table 4

Correlation Matrix for Three Depression Scales Across 1,617 Subjects

	Depression Scales		
	BDI	GDS	CESD
BDI	--	.763*	.778*
GDS	--	--	.726*
CESD	--	--	--

Note: *N*=1,617; * indicates *p*<.001

The results indicate that there is a high, significant relationship between the three depression measures, which is consistent with the literature (Brink & Niemeyer, 1992; Brink et al., 1982; Hyer & Blount, 1984), and with the hypothesis 1 stated in the Introduction.

The relationship between the depression scores and the "eveningness" measured by the H & O questionnaire was also examined, and the results are presented in Table 5.

Table 5

Correlation Between the H & O Questionnaire and the Three Depression Scales

	BDI	GDS	CESD
H&O	-.174*	-.182*	-.176*

Note: N=1,617; * indicates $p<.001$

As predicted in hypothesis 2, there was a significant and negative relationship between the performance on the H & O questionnaire and the three depression scales. The lower the score on the H & O (which indicates "eveningness") the higher the score on the depression scales (which is indicative of "probable" depression).

In addition, the relationship between STAI, the Trait scale and the three depression scales scores was examined. Table 6 represents the results.

Table 6

Correlation Between the STAI, the Trait Scale and the Three Depression Scales

	BDI	GDS	CESD
STAI	.738*	.731*	.777*

Note: N=1,617; * indicates $p<.001$

As expected, the correlation was strong and statistically significant, which is highly consistent with other research findings (Endler, Parker, Cox, & Bagby, 1992; Gotlib, 1984)

Part 2

Out of 1,617 subjects, 150 qualified for the second part of the study (high scores on 2 or 3 depression scales and either an evening type or a morning type). Out of those, 132 were the evening types and 18 were the morning types. Of the group, 65 evening types and 11 morning types agreed to participate. The ratio of the morning types to the evening types for the all 1,617 subjects from the first part of the study was 1:28. In the second part the ratio decreased to 1:13.

Table 7 presents the means and standard deviation scores for the depression scales for subjects who participated in the second part of the study.

Table 7

Means and Standard Deviations for the Three Depression Scales for Subjects in Part 2

Depression Scale	Mean	Standard Deviation
BDI	15.34	5.61
GDS	6.20	3.31
CESD	25.33	8.55

The mean score for the STAI the Trait scale was 49.67, SD=7.71 (the mean score for the whole sample was *M*=37.75, SD=10.21). Twenty four subjects were males (31.6%) and 52 were females (68.4%).

The age range was 18-40 and the average age was 21.07 (SD=4.26). However, there were significant differences in age among the two group types, $F(1, 74)=20.09$, $p<.01$. The mean age for the morning type was *M*=25.81 (SD=7.77) and for the evening type it was *M*=20.26 (SD=2.7). The two groups (evening, morning type) were similar to each other on WAIS-R vocabulary score, $F(1,74)=.33$, $p=.57$. The mean score of the morning type was *M*=45.36 (SD=7.65), and for the evening type *M*=43.68 (SD=9.14).

The relationship between sleep quality as measured by PSQI, and performance on the depression scales was examined and Table 8 presents these results.

Table 8

Correlation Between the PSQI and the Three Depression Scales

	BDI	GDS	CESD
PSQI	.328*	.256*	.364*

Note: N=76; * indicates $p<.01$

Although sleep quality was significantly correlated with performance on the three depression scales, subjects from the two groups (evening and morning types) showed a similar overall sleep quality indicated by the total score on the PSQI (the seven component scores were summed to yield a global PSQI score, which has a range of 0-21. The higher scores indicate worse sleep quality). However, there were significant differences between the two groups on Component 2 score of PSQI which measures sleep latency, $F(1,74)=6.28$, $p<.01$. The evening types obtained higher scores (C2=1.0 for the morning type, C2=1.66 for the evening type). It means that evening types took longer time to fall asleep, and that they more often could not get to sleep within 30 minutes.

To investigate the relationship between self-report measures of anxiety and depression a correlational analysis was performed on the scores on the STAI-the Trait and the State scales and subjects' performance on the three depression scales. Table 9 presents these results.

Table 9

Correlation Matrix for Measures of Anxiety and Depression

	Trait	State	BDI	GDS	CESD
Trait	--	.381*	.497*	.598*	.391*
State	--	--	.337*	.401*	.375*

Note: N=76; * indicates p<.01

As can be seen, all measures were significantly correlated. It should be noted that the correlations between the depression scales and the Trait scale was higher than the correlations between the depression scales and the State scale.

In the next phase of the analysis in Part 2 various analyses of variance and covariance were conducted. However, due to the very small number of the morning, "probably" depressed subjects the interpretation of the obtained results was meaningless. Despite the fact that the screening procedures were performed throughout the three consecutive semesters, as mentioned earlier, only 11 morning type subjects (out of 18 who met the criteria, 1.1% of the total sample) agreed to participate in the second part of the study. This low number is not surprising since the ratio of morning types to the evening types in the whole sample (1,617 students) was 1:28. In addition, among those few morning types only 6.3% were detected as "probably" depressed. Due to this small number of morning type subjects that participated in the second part of the study the power of the above analyses was very weak and additional analyses were conducted.

According to the researchers who looked at the "eveningness-morningness" dimension among depressed populations, about 50-75% of depressed patients show diurnality (for review see Reinik, Bouhuys, Wirz-Justice, & Hoofdakker, 1990). In these populations, 66-90% of the patients are evening types and 10-34% are morning types (Drennan et al., 1991). For this reason, in the additional analyses that were conducted the "probably" depressed evening types ($\underline{N}$=65) were compared with the nondepressed evening types ($\underline{N}$=71). The data for the nondepressed evening types was collected from the original sample. The collection of this data was a part of a separate project. Thus a description was not included in the procedure.

A series of mixed analyses of variance was performed for List A, List B and the recognition list. First, an analysis was performed for the immediate recall, then for the delayed recall. Finally, a series of mixed analyses of variance was performed for the Digits Forward and Digits Backward of the Digit Span test, and for the Digit Symbol test.

List A

Immediate recall

The number of words correctly recalled for each learning trial was computed for each subject. The number of perseverations (a word recalled more than one time per trial); intrusions (non-list words produced at recall); and semantic cluster responses (two or more words from the same semantic category recalled consecutively) were also computed for each learning trial.

A 2(group-"probably" depressed and nondepressed) X 3(time of day-9 a.m.; 2 p.m.; 8 p.m.) X 5(trial-5 levels) repeated measures analysis of variance was conducted separately for each of the four dependent variables. All subsequent comparisons were completed using Tukey's test ($p < .05$). All nonsignificant results are presented in Appendix E.

Correct responses

The analysis of the number of words correctly recalled (see Table 10 for means) revealed a significant main effect of group, $F(1,130)=12.51$, $p < .001$. The overall means were as follow: for nondepressed $M=11.48$ (SD=1.40), for "probably" depressed $M=10.36$ (SD=2.13).

There was also a significant main effect of trial, $F(4,520)=445.92$, $p < .001$. Subsequent analysis of this main effect indicated that significant improvements in recall were observed on each trial relative to the previous trial.

The mean number of words recalled were 7.04, 10.23, 11.79, 12.46, and 13.21, for trials 1-5, respectively.

Table 10

The Mean Number of Words Correctly Recalled During Learning Trials on the California Verbal Learning Test

Learning Trials	Nondepressed	"Probably" Depressed
1	7.66 (1.84)	6.35 (2.04)
2	10.82 (1.97)	9.59 (2.44)
3	12.42 (1.91)	11.11 (2.59)
4	12.96 (1.89)	11.91 (2.63)
5	13.55 (1.74)	12.85 (2.38)

*Note: Standard Deviations are in parentheses.

Perseverations

The analysis of the number of perseverations (a word recalled more than one time per trial), for learning trials showed only a significant main effect of trial, $F(4,520)=9.61$, $p<.001$ (see Table 11 for means). Subsequent analysis of this main effect indicated that there were significantly fewer perseverations on trial 1 than on trial 2, trial 3, trial 4, and trial 5. All the remaining pairwise comparisons were found to be nonsignificant.

Table 11

The Mean Number of Perseverations as a Function of Group and Learning Trials on the California Verbal Learning Test

Learning Trials	Nondepressed	"Probably" Depressed
1	.18 (0.59)	.12 (0.33)
2	.54 (1.14)	.34 (0.67)
3	.68 (0.88)	.49 (.071)
4	.78 (1.21)	.66 (1.28)
5	.75 (1.07)	.52 (0.94)

*Note: Standard Deviations are in parentheses.

Intrusions

The analysis of the number of intrusions (non-list words produced at recall), for learning trials showed a significant main effect of trials $F(4,520)=8.18$, $p<.001$, a significant time by trial interaction $F(8,520)=1.97$, $p<.05$, and a significant time by group by trial interaction, $F(8,520)=2.53$, $p<.01$ (see Table 12 for means).

Subsequent analysis of the main effect of trial revealed that all subjects had significantly more intrusions on trial 1 than on any other trial.

Table 12

The Mean Number of Intrusions as a Function of Group, Learning Trials and Times of Testing on the California Verbal Learning Test

Time	9 a.m.	2 p.m.	8 p.m.
Trial 1			
Nondepressed	.182	.333	.136
"Probably" Depressed	.300	.083	.429
Trial 2			
Nondepressed	.136	.111	.045
"Probably" Depressed	.000	.042	.095
Trial 3			
Nondepressed	.136	.148	.045
"Probably" Depressed	.150	.083	.000
Trial 4			
Nondepressed	.091	.148	.000
"Probably" Depressed	.000	.208	.000
Trial 5			
Nondepressed	.091	.185	.000
"Probably" Depressed	.150	.167	.000

The analysis of the time by group by trial interaction indicated that only on trial 1 were there significant differences between the groups. At 2 p.m. the "probably" depressed subjects had significantly less intrusions than the nondepressed subjects, and at 8 p.m. the "probably" depressed had significantly more intrusions than the nondepressed subjects.

Semantic clusters

The analysis of the number of semantic cluster responses for learning trials (two or more words from the same semantic category recalled consecutively), revealed a marginal main effect of group, $F(1,130)=2.91$, $p=.09$, and a significant main effect of trials $F(4,520)=26.08$, $p<.001$ (see Table 13 for means).

Table 13

The Mean Number and Mean Proportion of Semantic Clusters as a Function of Group and Learning Trials on the California Verbal Learning Test

Learning Trials	Nondepressed		"Probably" Depressed	
	Mean	MP	Mean	MP
1	2.11 (1.46)	0.38 (.22)	1.59 (1.48)	0.32 (.24)
2	4.25 (2.29)	0.54 (.25)	3.51 (2.33)	0.49 (.24)
3	5.41 (2.80)	0.59 (.27)	4.49 (3.01)	0.53 (.29)
4	6.34 (3.13)	0.66 (.29)	5.26 (3.38)	0.57 (.28)
5	6.90 (3.20)	0.69 (.28)	5.89 (3.38)	0.61 (.31)

*Note: MP=Mean proportion of cluster responses.

**Note: Standard Deviations are in parentheses.

Subsequent analysis of this main effect indicated that there were significantly fewer semantic clusters on trial 1 than on trial 2, trial 3, trial 4 and trial 5. Furthermore, there were significantly fewer semantic clusters on trial 2 than on trial 4 and trial 5. No other pairwise comparisons were significant.

The number of possible semantic cluster responses is directly related to the number of words correctly recalled. The nondepressed group consistently recalled more items from List A, therefore the nondepressed subjects had the opportunity to make a greater number of cluster responses. To make the groups equivalent in terms of the number of possible cluster responses, the number of actual semantic cluster responses was expressed as a proportion of the total possible cluster responses (see Crosson, Novack, Trenerry & Craig, 1988). To calculate cluster responses as a percentage of the total possible cluster responses (without respect to the number of categories used) the proportion of possible cluster responses was computed according to a procedure developed by Crosson et al. (1988). These authors argued that when two items from the same category are consecutively recalled, one cluster response is scored. Therefore, on any given trial, when correct responses (CR) are less than or equal to 4, possible cluster (PC)=CR-1. When CR is greater than 4 and less than or equal to 8, PC=CR-2. When CR is greater than 8 and less or equal to 12, PC=CR-3. When CR is greater than 12 and less than or equal to 16, PC=CR-4. Proportion of possible cluster responses is then the actual cluster responses divided by the possible cluster responses (PC). The analysis of the proportion of cluster responses for learning trials revealed a marginal main effect of group, $F(1,130)=3.69$, $p=.057$ and a significant main effect of trial, $F(4,520)=45.61$, $p<.001$. The overall group means were as follow, for the nondepressed group $M=.57$ (SD=.19) and for the "probably" depressed group $M=.50$ (SD=.20). The subsequent analysis of the main effect of trial revealed that semantic clustering was significantly lower on trial 1 than on trial 2, trial 3, trial 4, and trial 5. Also, semantic clustering was significantly lower on trial 2 than on trial 4 and trial 5. Furthermore, semantic clustering was significantly lower on trial 3 than on trial 5.

Delayed recall

The number of correct responses, perseverations, and intrusions for delayed recall trials were each subjected to a 2(group-"probably" depressed and nondepressed) X 3(time of day-9 a.m.; 2 p.m.; 8 p.m.) X 2(short vs. long delay) X 2(free vs. cued testing) mixed analysis of variance.

Correct responses

The analysis for correct responses revealed a significant main effect of delay, $F(1,130)=13.75$, $p<.001$, and a significant main effect of testing, $F(1,130)=38.20$, $p<.001$. These main effects indicated that the mean number of words recalled was lower for short-delay (M=12.36, SD=2.14) than for long-delay (M=12.70, SD=2.18), and recall was greater under cued-recall (M=12.86, SD=1.98) than free-recall (M=12.21, SD=2.37).

A significant delay by testing interaction, $F(1,130)=4.83$, $p<.05$, and a marginal group by delay by testing interaction, $F(1,130)=3.79$, $p=.054$ were also observed (see Table 14 for means).

Table 14

The Mean Number of Correct Responses on Delayed Recall Trials of the California Verbal Learning Test as a Function of Group and Delay

Delayed Recall Trials	Nondepressed	"Probably" Depressed
Short Delay Free	12.28 (2.19)	11.59 (2.87)
Short Delay Cued	12.94 (1.84)	12.60 (2.14)
Long Delay Free	12.73 (2.32)	12.20 (2.65)
Long Delay Cued	13.32 (1.89)	12.51 (2.27)

*Note: Standard Deviations are in parentheses.

Subsequent analysis of the delay by testing interaction indicated that subjects in both groups recalled significantly more correct words on the short-delay cued-recall (M=12.78, SD=1.98) than on the short-delay free-recall (M=11.95, SD=2.55) as well as more correct words on the long-delay cued-recall (M=12.93, SD=2.11) than on the long-delay free-recall (M=12.48, SD=2.49).

To examine the efficiency of memory after learning has been equated between groups, the number of items remembered on the delayed recall trials was converted to the proportion of their highest learning trial (see Table 15 for means).

Table 15

The Mean Number of Words Recalled Presented as a Proportion of the Highest Learning Trial for Delayed Recall Trials of the California Verbal Learning Test as a Function of Group and Delay

Delayed Recall Trials	Nondepressed	"Probably" Depressed
Short Delay Free	.88 (.11)	.88 (.13)
Short Delay Cued	.93 (.09)	.97 (.13)
Long Delay Free	.91 (.13)	.93 (.12)
Long Delay Cued	.96 (.09)	.96 (.10)

*Note: Standard Deviations are in parentheses.

This analysis revealed a significant main effect of delay, $F(1,130)=13.80$, $p<.001$, and a significant main effect of testing, $F(1,130)=38.26$, $p<.001$. These main effects indicated that recall improved with delay (for the short-delay M=.91, SD=.01, for the long-delay M=.94, SD=.10) and cued-recall was higher than free-recall (for cued-recall *M*=.96, SD=.10, and for the free-recall *M*=.90, SD=.10).

A significant delay by testing interaction, $F(1,130)=6.61$, $p<.01$, and a significant group by delay by testing interaction, $F(1,130)=4.84$, $p<.05$ were observed. Subsequent analysis of the three-way interaction indicated that the number of words recalled presented as a proportion of the highest learning was significantly higher for the "probably" depressed subjects than for the nondepressed subjects in the short-delay cued-recall testing. All the remaining pairwise comparisons were found to be nonsignificant.

Perseverations

The analysis of perseverations revealed a significant main effect for delay, $F(1,130)=9.16$, $p<.01$, a significant main effect of testing $F(1,130)=23.44$, $p<.001$, and a significant delay by testing interaction, $F(1,130)=5.89$, $p<.05$ (see Table 16 for means). Subsequent analysis of this interaction indicated that there were significantly more perseverations on the short-delay free-recall than on the short-delay cued-recall, and there were more perseverations on the long-delay free-recall than on the long-delay cued-recall. Furthermore, there were significantly more perseverations on the short-delay than the long-delay with the free-recall testing. With cued-recall testing there were no significant differences in the number of perseverations at both levels of delay (short and long delay).

Table 16

The Mean Number of Perseverations on Delayed Recall Trials of the California Verbal Learning Test as a Function of Group and Delay

Delayed Recall Trials	Nondepressed	"Probably" Depressed
Short Delay Free	.32 (.79)	.48 (1.23)
Short Delay Cued	.04 (.20)	.03 (0.25)
Long Delay Free	.20 (.47)	.09 (.29)
Long Delay Cued	.01 (.12)	.00 (0.00)

*Note: Standard Deviations are in parentheses.

Intrusions

The analysis of the number of intrusions on delayed recall trials of the California Verbal Learning Test showed no main effects. However, a marginal group by time by delay by testing interaction was found, $F(2,130)=2.86$, $p=.061$. Table 17 on the next page presents the means among the nondepressed and the "probably" depressed subjects.

Table 17

The Mean Number of Intrusions on Delayed Recall Trials of the California Verbal Learning Test as a Function of Group and Delay

Delayed Recall Trials	Nondepressed	"Probably" Depressed
Short Delay Free	.23 (0.48)	.20 (.47)
Short Delay Cued	.37 (0.66)	.29 (.68)
Long Delay Free	.42 (1.18)	.28 (.57)
Long Delay Cued	.32 (0.67)	.32 (.75)

*Note: Standard Deviations are in parentheses.

Semantic Clusters

In addition a 2(group-"probably" depressed and nondepressed) X 3(time of day-9 a.m.; 2 p.m.; 8 p.m.) X 2(delay-short vs. long delay) mixed analyses of variance were conducted for semantic cluster responses and for the proportion of cluster responses (see Table 18 for means).

The analysis revealed a significant main effect of delay, $F(1,130)=16.53$, $p<.001$. The mean for the short delay was $M=6.32$ (SD=2.89), for the long delay $M=7.04$ (SD=2.92). The analysis of the proportion of cluster responses revealed a marginal effect of group, $F(1,130)=3.64$, $p=.059$, and a significant main effect of delay, $F(1,130)=8.17$, $p<.01$. The mean for the short delay was _M_=.71 (SD=.24), for the long delay _M_=.76 (SD=.23).

Table 18

The Mean Number and Mean Proportion of Cluster Responses on Delayed Recall Trials of the California Verbal Learning Test as a Function of Group and Delay

Delayed Recall Trials	Nondepressed		"Probably" Depressed	
	Mean	MP	Mean	MP
Short Delay Free	6.76 (2.58)	0.75 (.22)	5.85 (3.15)	0.67 (.26)
Long Delay Free	7.41 (2.81)	0.79 (.23)	6.63 (3.00)	0.73 (.24)

*Note: MP=Mean proportion of cluster responses.

**Note: Standard Deviations are in parentheses.

List B

The number of words correctly recalled, perseverations, intrusions, semantic cluster responses and the proportion of total possible cluster responses was a subject to 2(group) X 3(time) analysis of variance (see Table 19 for means).

In all these analyses, only when the correct responses were considered, a marginal effect of group was found, $F(1,130)=3.45$, $p=.065$. The mean for the nondepressed group was <u>M</u>=6.99 (SD=1.92), for the "probably" depressed group <u>M</u>=6.37 (SD=1.76).

Table 19

List B for Correct Responses, Perseverations, Intrusions, and Cluster Responses as a Function of Group

	Nondepressed	"Probably" Depressed
Correct Responses	6.99 (1.92)	6.37 (1.76)
Perseverations	0.06 (0.23)	0.03 (0.17)
Intrusions	0.11 (0.40)	0.14 (0.39)
Cluster Responses	1.85 (1.46)	1.99 (1.50)
Cluster Responses (Proportion)	0.36 (0.25)	0.42 (0.27)

*Note: Standard Deviations are in parentheses.

Recognition list

The number of words correctly recalled was subject to a one-way analysis of variance (see Table 20 for means).

Results were found to be not significant. Recognition word error types were divided as follows: list B words, shared category (BS), list B words, nonshared category (BN), neither list words, prototypical category (NP), neither list words, phonemically similar category (PS), neither list words, unrelated category (UN). The recognition errors were subject to a 2(group) X 5(error type) mixed analysis of variance. No significance was found.

Table 20

California Verbal Learning Test Recognition Trial Means for Correct Responses and Error Types as a Function of Group

	Nondepressed	"Probably" Depressed
Correct Recognitions	15.18 (.98)	14.95 (1.11)
Error Types		
List B Related	.28 (.59)	.26 (.48)
List B Unrelated	.10 (.35)	.03 (.17)
Neither List Related	.13 (.34)	.14 (.39)
Phonemic Errors	.31 (.58)	.20 (.44)
Neither List Unrelated	.04 (.20)	.03 (.17)

*Note: Standard Deviations are in parentheses.

Finally, 2(group) X 3(time of day) analyses of variance were conducted for the Digits Forward and Digits Backward of the Digit Span test, and for the Digit Symbol test. The results for the Digit Span tests were found to be not significant. The analysis of the performance on the Digit Symbol test revealed a main effect of group, $\underline{F}(1,129)=20.54$, $\underline{p}<.001$. The overall means were as follow: for nondepressed $\underline{M}=74.70$ (SD=8.37), for "probably" depressed $\underline{M}=67.95$ (SD=8.66).

CHAPTER IV

DISCUSSION

The present study was conducted in order to clarify some of the questions left unanswered by recent research findings in the literature covering sleep, depression, time of day, and type of person. First, performance on the Beck Depression Inventory (BDI), Geriatric Depression Scale-Short Form (GDS-SF), and Center for Epidemiological Studies Depression (CESD) was compared. Second, the "eveningness-morningness" dimension, as measured by the Horne and Ostberg questionnaire (H&O), was examined among the "probably" depressed student population. Third, an impact of the "probable" depression on performance on various memory tests at different times of day was investigated. In addition, performance of the "probably" depressed students was compared with performance of the nondepressed students.

The Beck Depression Inventory (BDI), Geriatric Depression Scale-Short Form (GDS-SF), Center for Epidemiological Studies Depression (CESD) are all well-established measures of depression that are commonly used in research and clinical settings. These scales vary in form, length, difficulty in completing, and of course in final results. The question for the present study was, which scale detects the "probable" depression most accurately and which scale is easiest to use in a research setting?

As predicted in the hypothesis statement, the scores on all three scales were highly and significantly correlated which is consistent with the literature (Beck & Beamesderfer, 1974; Brink et al., 1982; Brink & Niemeyer, 1992; Hyer & Blount, 1984). However, the present findings suggest that GDS-SF serves these functions, mentioned in the above question, the best. The performance on GDS-SF was most consistent with national trends for "probable" depression within the examined age range. The GDS-SF is also the easiest one of the three depression scales to complete because it has only fifteen short questions with YES or NO answer while the CESD has twenty questions with four alternatives and the BDI has twenty one questions with four different answers to each question for a testee to choose. Furthermore, the GDS-SF excludes items that are confounded with normal aging and diseases associated with older ages (Brink, et al., 1982, Ferraro & Chelminski, in press), thus it assesses primarily psychological components of depression while BDI and CESD measure cognitive symptoms of depression in addition to affective, behavioral, interpersonal, and somatic (Beck, et al., 1961; Radloff & Teri, 1986). Due to this fact, some testees who are depressed might have more difficulties completing these other two scales than the GDS-SF.

In addition, a correlational analysis was performed on the four components of the CESD (Depressed Affect, Positive Affect, Somatic, and Interpersonal). This analysis revealed that the Interpersonal component scores were less correlated with the BDI and GDS-SF scores as compared to the scores of the other three components of the CESD. The Interpersonal component scores also correlated less with the scores on the STAI-(Trait scale) as compared to the scores of the other three components of the CESD. The correlation between the Interpersonal component scores and the scores on the STAI-(State scale) was very weak and not significant. These findings suggest that the Interpersonal component may simply measure something else rather than a distinct construct such as depression. If this is true than the CESD may not be the best choice for a research instrument for depression screening due to this limitation.

The "eveningness-morningness" dimension, as measured by the Horne and Ostberg scale, is not a new concept, and there is abundant research data on the subject matter of this test. However, there is no published report indicating the base rates for the three types described by Horne and Ostberg-the neither type, the morning type, and the evening type. It was noted in the Introduction that the "eveningness-morningness" dimension had been found to be related to age. Thus, the base rates would differ for different age groups. The present study found that out of

1,617 students 1,009 (62.4%) were the neither type, 135 (8.3%) students were the morning type, and 473 (29.3%) students were the evening type. As can be seen, very few students were the morning types, and most of them were significantly older than the students who were the other two types.

The results of the research investigating the relationship between gender and circadian typology indicate that the scores on circadian rhythms questionnaires are independent of the sex of the subjects (for review, see Tankova et al., 1994). The results of the present study, however, revealed significant differences between gender. Female subjects of this study showed significantly stronger tendency toward morningness. The discrepancy with the other research findings might be due to the fact that in all studies reported in Tankowa et al. (1994) researchers used substantially smaller samples (between 100 and 900 subjects), when compared to the present study. It is possible that because the incidence of "morningness" among people is very low, as found in the present findings, the size of a researched sample have an impact on test of independence of gender and typology.

The distribution of the three types among those who were detected as "probably" depressed was approximately the same for each of the three depression scales. However, the results did not confirm the hypothesis 2, stated in the

Introduction. It was expected that there would be a high, negative correlation between the Horne and Ostberg questionnaire scores and the performance across the three depression scales. The present study found that these correlations were significant and negative but not as strong as expected ($r=-.182$ for GDS-SF, $r=-.174$ for BDI, $r=-.176$ for CESD, all p's $<.001$). According to more recent research findings, about 50-75% of depressed patients show diurnality (Reinik et al., 1990). In these populations, 66-90% of the patients are evening types and 10-34% are morning types. Others have found that depressed patients reported significantly more symptoms of "eveningness" than age- and sex-matched controls (Drennan et al., 1991). These findings constituted the rationale for the speculation that the increased "eveningness" in depressed patients may be not just a characteristic of the depressive state, but it may rather reflect a premorbid trait, or vulnerability.

However, the present results do not confirm these findings. In the Introduction, the hypothesis 3 stated that most of the subjects that were detected as "probably" depressed would be found as the evening types. However, the results showed that the majority of those who were detected as "probably" depressed were the neither type. The average percentage of the neither types for the three depression scales was 55.7%, for the evening types it was 38.27%, and for the morning types it was 6.03% respectively.

In the Introduction, it has been speculated that to be a morning type might serve as a protection against depression, whereas "eveningness" might cause increased vulnerability. The low percentage of the morning types among the "probably" depressed found in the current study can be seen as a confirmation of this hypothesis. However, it has to be noted that the incidence of the morning types in the whole sample (1,617 students) was only 8.3%. Thus, the reason for the low frequency of the morning types among the "probably" depressed might be due to the low base rate rather than to some unique, protective characteristics of "morningness" against depression.

The present study is an anologue study and only "probably" depressed students were examined. It is possible that the distribution of the three types among the depressed subjects would get closer to the other research findings, cited earlier, if more stringent criteria had been used for defining a subject to be depressed.

Still, there might be another explanation for the difference between the findings of the present study and those cited earlier. The subjects that were used in earlier studies were already suffering from depression and their types might have altered due to the illness. Thus, we can't really know for sure whether the increased "eveningness" in those depressed patients is simply a characteristic of the depressive state, or it reflects a premorbid trait.

Another purpose of this study was to examine the impact of the "probable" depression on performance on various memory tests across different times of day. Four instruments were used: the California Verbal Learning Test (CVLT) that is a neuropsychological assessment instrument used to assess multiple parameters of verbal learning and memory (Delis et al., 1987), the Digit Span subtest of the WAIS-R that is a measure of short-term auditory memory and attention (the Digits Forward involves rote learning and memory, the Digits Backward requires additional transformation of the stimulus input prior to recall), and the Digit Symbol subtest of the WAIS-R (Sattler, 1992), that can be conceptualized as an information-processing task involving the discrimination and memory of visual pattern symbols.

Cognitive deficits resulting from the depressive illness have been well documented (for review see Otto et al., 1994). Depression affects neuropsychological test performance to such a degree that misdiagnosis of depressed patients as having organic brain damage often occurs (Otto et al., 1994). The present study investigated the impact of "probable" depression on some cognitive functions, manifested as memory performance. One measure of the ability to encode information into memory is the immediate free recall of information following presentation of a stimulus. In this study, the "probably" depressed subjects consistently recalled less items from List A of the CVLT than the nondepressed subjects, which is consistent with the proposed hypothesis. On each of the five trials the performance of the nondepressed subjects was significantly greater than the performance of the "probably" depressed.

The CVLT differs from traditional clinical memory tests because it assesses not only single achievement scores but also assesses the strategies, processes, and errors examinees display in remembering verbal material. Moreover, the CVLT quantifies such variables as semantic clustering (the most effective learning strategy-Delis et al., 1987) in recall, recall consistency, vulnerability to proactive and retroactive interference, retention of information over short and long delays, error types, and signal detection parameters (discriminability and response bias) in recognition memory (Delis, Massman, Kaplan, McKee, Kramer, & Gettman, 1991). The results of the present study indicate that after interference (List B) and a twenty minute delay the "probably" depressed subjects performed more poorly than did the nondepressed subjects, as was expected. However, the results did not reach statistical significance.

To examine the efficiency of memory after learning has been equated between groups, the number of items remembered on the delayed recall trials was converted to the proportion of their highest learning trial. Surprisingly, the number of words recalled presented as a proportion of the highest learning was significantly higher for the "probably" depressed subjects than for the nondepressed subjects in the short-delay cued-recall testing. This unexpected finding may be related to the fact that the "probably" depressed subjects showed substantial improvement in the cued-recall as compared to the free-recall, while the nondepressed subjects who had already high free-recall did not show much improvement.

Providing semantic cues in free recall procedures can provide information in the differentiation of retrieval from encoding of memory processes. This means that if recall dramatically improves from free recall to cued recall, as it was in the case of the "probably" depressed subjects, a problem with retrieval is indicated.

Finally, the number of words recalled over five trials was compared to the normative data (Wiens, Tindall, & Crossen, 1994). Relative to the normative populations, "probably" depressed subjects in this study generally scored one-half of the standard deviation below expectation on the CVLT, which is consistent with the trend expected in the original hypothesis.

The two groups differed significantly on the performance on the Digit Symbol test. The nondepressed subjects coded consistently more symbols than the "probably" depressed subjects. The Digit Symbol test involves the speed and accuracy of visual-motor coordination, attentional skills, short-term memory, and cognitive flexibility

(Sattler, 1992). The present results suggest that "probable" depression, which is not as severe as a clinical depressive disorder, is still debilitating enough to significantly impair these cognitive and memory functions.

One of the goals of investigating the impact of the "probable" depression on performance on various memory tests was to examine whether different times of day have an influence on the level of performance. Unexpectedly, the present results revealed no main effect of time of day in almost all analyses that were conducted. Only when intrusions were analyzed in immediate recall of List A across five trials, a significant group by time by trial interaction was found. It indicated that at 2 p.m. the "probably" depressed subjects had significantly less intrusions than the nondepressed subjects, and at 8 p.m. the "probably" depressed had significantly more intrusions than the nondepressed subjects.

The lack of significant effects of time in presented analyses might be due to the fact that only the evening type subjects were examined. Perhaps, if the evening types were contrasted with morning types the statistical instruments used might have had more power, and expected pattern of results would have been seen.

The findings related to the effect of time of day on memory performance are inconsistent with much of the literature (Anderson et al., 1991; Casal et al., 1990; Horne et al., 1980; May et al., 1993; Petros, Beckwith, & Anderson, 1990). However, in all of these studies instruments other than the CVLT were used. The effect of time of day on the CVLT performance has not been documented yet, except now in the present study (also in unpublished manuscript, submitted for the MPA conference, Chelminski, Suda, Ferraro, Petros & Beckwith, 1996) Furthermore, the researchers who investigated overall performance on CVLT, usually utilized head injured or organically brain damaged populations. These facts might explain the discrepant findings of the present study. It might be possible that the cognitive functioning of a college student population is too high for an instrument such as CVLT to detect an impact of time of day on memory performance.

In summary, the findings in the present study confirm hypothesis that the scores on BDI, GDS-SF, and CESD are highly and significantly correlated, which is consistent with the literature. In addition, the results indicate that GDS-SF detects the "probable" depression most accurately and is the easiest out of the three scales to use in a research setting.

The present findings also showed a significant, negative correlation between the Horne and Ostberg questionnaire scores and the performance across the three depression scales as was expected. However, this correlation was lower than it was predicted. Future research investigating the relationship between "eveningness" and "probable" depression should include subjects from wider age range. The circadian typology varies in different age groups thus the relationship between "eveningness" and "probable" depression might change in a population that includes different age groups.

In addition, the results of present study showed that "probable" depression has a significant impact on performance on various memory tests among college students. In this study, the "probably" depressed subjects consistently recalled less items from List A of the CVLT than the nondepressed subjects. They also demonstrated problem with retrieval and they showed significantly lower efficiency of memory. The "probably" depressed subjects also demonstrated significantly poorer performance on the Digit Symbol test.

Finally, the present findings support the utilization of the CVLT as a useful measure of memory in the research with a college population. In addition to detecting verbal memory deficits, this test provides valuable clinical information in terms of individuals' ability to learn and organize memory.

Future studies investigating the relationship between "eveningness" and depression should utilize clinically depressed male and female subjects. Furthermore, in order to obtain sufficient number of morning type subjects, participants need to represent a wide range of age. Also, due to the fact that no conclusive findings have been reported in the literature, in regards to whether the "eveningness-morningness" is a relatively enduring, stable characteristic, determined endogenously, longitudinal studies are needed with work schedules being controlled.

APPENDIX A

GERIATRIC DEPRESSION SCALE-SHORT FORM

GDS-SF

Choose best answers for how you have felt over the PAST WEEK:

1. Are you basically satisfied with your life?	YES/NO
2. Have you dropped many of your activities and interests?	YES/NO
3. Do you feel that your life is empty?	YES/NO
4. Do you often get bored?	YES/NO
5. Are you in good spirits most of the time?	YES/NO
6. Are you afraid that something bad is going to happen to you?	YES/NO
7. Do you feel happy most of the time?	YES/NO
8. Do you often feel helpless?	YES/NO
9. Do you prefer to stay home, rather than going out and doing new things?	YES/NO
10. Do you feel you have more problems with memory than most?	YES/NO
11. Do you think it is wonderful to be alive now?	YES/NO
12. Do you feel pretty worthless the way you are now?	YES/NO
13. Do you feel full of energy?	YES/NO
14. Do you feel that your situation is hopeless?	YES/NO
15. Do you think that most people are better off than you are?	YES/NO

APPENDIX B

CENTER FOR EPIDEMIOLOGICAL STUDIES DEPRESSION SCALE

(CESD)

INSTRUCTIONS: Circle the number for each statement which best describes how often you felt this way DURING THE PAST WEEK.

Following scoring was used:
1 Rarely or None of the Time (less than 1 day)
2 Some or a Little of the Time (1-2 days)
3 Occasionally or Moderate Amount of Time (3-4 days)
4 Most or All of the Time (5-7 days)

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake of the blues even with help of my friend or family.
4. I felt that I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.
11. My sleep was restless.
12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people disliked me.
20. I could not get "going".

APPENDIX C

HORNE AND OSTBERG QUESTIONNAIRE (H & O)

Instructions:

Please read each question carefully before answering. Answer ALL questions. Answer questions in numerical order. Each question should be answered independently of others. Do NOT go back and check your answers. All questions have a selection of answers. For each question place a cross alongside ONE answer only. Some questions have a scale instead of a selection of answers. Place a cross at the appropriate point along the scale.

Please answer each question honestly as possible. Both your answers and the results will be kept in strict confidence.

1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?
AM
5______6______7______8______9______10______11______12______

2. Considering only your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening
PM
8______9______10______11______12AM______1______2______3_____

3. If there is a specific time at which you have to get up in the morning, to what extent are you dependent on being woken up by an alarm clock?

Not at all dependent	___(4)
Slightly dependent	___(3)
Fairly dependent	___(2)
Very dependent	___(1)

4. Assuming adequate environmental conditions, how easy do you find getting up in the morning?

Not at all easy ___(4)
Not very easy ___(3)
Fairly easy ___(2)
Very easy ___(1)

5. How alert do you feel during the first half-hour after having woken up in the morning?

Not at all alert ___(1)
Slightly alert ___(2)
Fairly alert ___(3)
Very alert ___(4)

6. How is your appetite during the first half-hour after having woken up in the morning?

Very poor ___(1)
Fairly poor ___(2)
Fairly good ___(3)
Very good ___(4)

7. During the first half-hour after waking up in the morning, how tired do you feel?

Very tired ___(1)
Fairly tired ___(2)
Fairly refreshed ___(3)
Very refreshed ___(4)

8. When you have no commitments the next day, at what time do you go to bad compared to your usual bedtime?

Seldom or never late ___(4)
Less than 1 hour later ___(3)
1-2 hours later ___(2)
More than 2 hours later ___(1)

9. You have decided to engage in some physical exercise. A friend suggests that you do this 1 hour twice a week and the best time for him is between 7:00 and 8:00 AM. Bearing in mind nothing else but only your own "feeling best" rhythm, how do you think you would perform?

Would be on good form ___(4)
Would be on reasonable form ___(3)
Would find it difficult ___(2)
Would find it very difficult ___(1)

10. At what time in the evening do you feel tired and as a result in need of sleep?
PM8____9______10______11______12AM______1______2______3____

11. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for 2 hours. You are entirely free to plan your day and considering only your own "feeling best" rhythm, which ONE of the four testing times would you choose?
8:00-10:00 AM ___(6)
11:00AM-1:00PM ___(4)
3:00-5:00PM ___(2)
7:00-9:00PM ___(0)

12. If you went to bed at 11:00PM, at what level of tiredness would you be?
Not at all tired ___(0)
A little tired ___(2)
Fairly tired ___(3)
Very tired ___(5)

13. For some reason you have gone to bed several hours later than usual but there is no need to get up at any particular time the next morning. Which ONE of the following events are you most likely to experience?
Will wake up at usual time and will NOT fall asleep ___(4)
Will wake up at usual time and will doze thereafter ___(3)
Will wake up at usual time and will fall asleep again ___(2)
Will NOT wake up until later than usual ___(1)

14. One night you have to remain awake between 4:00-6:00AM in order to carry out a night watch. You have no commitments the next day. Which ONE of the following alternatives will suit you best?
Would NOT go to bed until watch was over ___(1)
Would take a nap before and sleep after ___(2)
Would take a good sleep before and nap after ___(3)
Would take ALL sleep before watch ___(4)

15. You have to do 2 hours of hard, physical work. You are entirely free to plan your day and considering only your own "feeling best" rhythm, which ONE of the following times would you choose?

8:00-10:00AM ___(4)
11:00-1:00AM ___(3)
3:00-5:00PM ___(2)
7:00-9:00PM ___(1)

16. You have decided to engage in some physical exercise. A friend suggests that you do this 1 hour twice a week and the best time for him is between 10:00-11:00PM. Bearing in mind nothing else but only your own "feeling best" rhythm, how do you think you would perform?

Would be on good form ___(1)
Would be on reasonable form ___(2)
Would find it difficult ___(3)
Would find it very difficult ___(4)

17. Suppose that you can choose your own work hours. Assume that you worked a FIVE hour day (including breaks) and that your job was interesting and paid by results. Which FIVE CONSECUTIVE HOURS would you select?

12 1 2 3 4 5 6 7 8 9 10 11 **12** 1 2 3 4 5 6 7 8 9 10 11 12
MIDNIGHT NOON

18. At what time of the day do you think that you reach your "feeling best" peak?

12 1 2 3 4 5 6 7 8 9 10 11 **12** 1 2 3 4 5 6 7 8 9 10 11 12
MIDNIGHT NOON

19. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?

Definitely a "morning" type ___(6)
Rather more a "morning" than an "evening" type ___(4)
Rather more an "evening" than a "morning" type ___(2)
Definitely an "evening" type ___(0)

APPENDIX D

CALIFORNIA VERBAL LEARNING TEST

LIST A	**LIST B**
DRILL	TOASTER
PLUMS	CHERRIES
VEST	HALIBUT
PARSLEY	GINGER
GRAPES	PINEAPPLE
PAPRIKA	SPATULA
SWEATER	OREGANO
WRENCH	FLOUNDER
CHIVES	SAGE
TANGERINES	LEMONS
CHISEL	COD
JACKET	SKILLET
NUTMEG	PEACHES
APRICOTS	SALMON
PLIERS	CINNAMON
SLACKS	BOWL

APPENDIX E

NONSIGNIFICANT RESULTS

Table 21

Nonsignificant Results

2(group) X 3(time of day) X 5(trial) Analyses of Variance

Immediate Recall

List A

Correct responses

Source	F value	p value
Time	F(2,130)= .34	p=.711
Time by Group	F(2,130)= .62	p=.540
Time by Trial	F(8,520)= .96	p=.464
Group by Trial	F(4,520)=1.27	p=.282
Time by Group by Trial	F(8,520)= .65	p=.736

Perseverations

Source	F value	p value
Time	F(2,130)= .10	p=.909
Group	F(1,130)=2.10	p=.150
Time by Group	F(2,130)=1.96	p=.145
Time by Trial	F(8,520)= .89	p=.527
Group by Trial	F(4,520)= .24	p=.918
Time by Group by Trial	F(8,520)= .23	p=.986

Intrusions

Source	F value	p value
Time	F(2,130)= .89	p=.415
Group	F(1,130)= .01	p=.908
Time by Group	F(2,130)= .62	p=.539
Group by Trial	F(4,520)= .66	p=.619

Semantic Clusters

Source	F value	p value
Time	F(2,130)= .40	p=.672
Group	F(1,130)=2.91	p=.090
Time by Group	F(2,130)= .98	p=.379
Time by Trial	F(8,520)=1.02	p=.422
Group by Trial	F(4,520)=1.05	p=.383
Time by Group by Trial	F(8,520)=1.09	p=.371

Proportion of Semantic Clusters

Source	F value	p value
Time	F(2,130)= .54	p=.584
Group	F(1,130)=3.69	p=.057
Time by Group	F(2,130)= .21	p=.808
Time by Trial	F(8,520)=1.46	p=.169
Group by Trial	F(4,520)= .16	p=.958
Time by Group by Trial	F(8,520)=1.11	p=.353

List B

2(group) X 3(time) Analyses of Variance

Correct

Source	F value	p value
Time	F(2,130)= .09	p=.913
Group	F(1,130)=3.45	p=.065
Time by Group	F(2,130)= .17	p=.843

Perseverations

Source	F value	p value
Time	F(2,130)=1.82	p=.166
Group	F(1,130)= .54	p=.465
Time by Group	F(2,130)= .18	p=.835

Intrusions

Source	F value	p value
Time	F(2,130)= .60	p=.553
Group	F(1,130)= .24	p=.626
Time by Group	F(2,130)=1.20	p=.305

Semantic Clusters

Source	F value	p value
Time	F(2,130)= .05	p=.948
Group	F(1,130)= .13	p=.714
Time by Group	F(2,130)= .90	p=.409

Proportion of Semantic Clusters

Source	F value	p value
Time	F(2,130)= .35	p=.705
Group	F(1,130)=2.32	p=.130
Time by Group	F(2,130)=2.17	p=.118

Dealyed recall

2(group) X 3(time) X 2(delay) X 2(testing) Analyses of Variance

Correct responses

Source	F value	p value
Time	F(2,130)= .20	p=.823
Group	F(1,130)=2.46	p=.119
Time by Group	F(2,130)= .51	p=.602
Time by Delay	F(2,130)=1.50	p=.227
Group by Delay	F(1,130)= .66	p=.419
Time by Group by Delay	F(2,130)= .24	p=.791
Time by Testing	F(2,130)= .58	p=.562
Group by Testing	F(1,130)= .02	p=.876
Time by Group by Testing	F(2,130)= .21	p=.809
Time by Delay by Testing	F(2,130)=1.31	p=.272
Time by Group by Delay by Testing	F(2,130)=2.54	p=.083

Proportion of Highest Learning

Source	F value	p value
Time	F(2,130)= .69	p=.503
Group	F(1,130)=1.05	p=.307
Time by Group	F(2,130)= .33	p=.720
Time by Delay	F(2,130)=2.15	p=.121
Group by Delay	F(1,130)= .56	p=.457
Time by Group by Delay	F(2,130)= .11	p=.897
Time by Testing	F(2,130)= .52	p=.598
Group by Testing	F(1,130)= .44	p=.507
Time by Group by Testing	F(2,130)= .03	p=.966
Time by Delay by Testing	F(2,130)=1.23	p=.297
Time by Group by Delay by Testing	F(2,130)=2.08	p=.129

Perseverations

Source	F value	p value
Time	F(2,130)= .57	p=.568
Group	F(1,130)= .05	p=.824
Time by Group	F(2,130)= .87	p=.421
Time by Delay	F(2,130)= .29	p=.750
Group by Delay	F(1,130)=2.25	p=.136
Time by Group by Delay	F(2,130)= .73	p=.482
Time by Testing	F(2,130)= .50	p=.610
Group by Testing	F(1,130)= .16	p=.686
Time by Group by Testing	F(2,130)= .11	p=.894
Time by Delay by Testing	F(2,130)= .79	p=.454
Group by Delay by Testing	F(1,130)=1.89	p=.171
Time by Group by Delay by Testing	F(2,130)= .05	p=.950

Intrusions

Source	F value	p value
Time	F(2,130)= .49	p=.616
Group	F(1,130)= .54	p=.465
Time by Group	F(2,130)=1.17	p=.313
Delay	F(1,130)=1.78	p=.184
Time by Delay	F(2,130)=1.14	p=.323
Group by Delay	F(1,130)= .06	p=.807
Time by Group by Delay	F(2,130)= .13	p=.882
Testing	F(1,130)= .75	p=.387
Time by Testing	F(2,130)=1.37	p=.257
Group by Testing	F(1,130)= .20	p=.653
Time by Group by Testing	F(2,130)= .18	p=.838
Delay by Testing	F(1,130)=3.03	p=.084
Time by Delay by Testing	F(2,130)= .22	p=.804
Group by Delay by Testing	F(1,130)=1.85	p=.176
Time by Group by Delay by Testing	F(2,130)=2.86	p=.061

Semantic Clusters

Source	F value	p value
Time	F(2,130)= .41	p=.665
Group	F(1,130)=3.10	p=.081
Time by Group	F(2,130)= .19	p=.826
Time by Delay	F(2,130)= .93	p=.396
Group by Delay	F(1,130)= .21	p=.646
Time by Group by Delay	F(2,130)= .77	p=.463

Proportion Of Semantic Clusters

Source	F value	p value
Time	F(2,130)= .74	p=.478
Group	F(1,130)=3.64	p=.059
Time by Group	F(2,130)= .11	p=.898
Time by Delay	F(2,130)= .51	p=.601
Group by Delay	F(1,130)= .29	p=.594
Time by Group by Delay	F(2,130)= .88	p=.418

Recognition List (Hits)

2(group) X 3(time) Analyses of Variance

Source	F value	p value
Time	F(2,130)= .79	p=.456
Group	F(1,130)=1.58	p=.211
Time by Group	F(2,130)= .28	p=.753

Digits Forward

2(group) X 3(time) Analyses of Variance

Source	F value	p value
Time	F(2,130)= .28	p=.755
Group	F(1,130)=1.46	p=.230
Time by Group	F(2,130)= .18	p=.839

Digits Backward

2(group) X 3(time) Analyses of Variance

Source	F value	p value
Time	F(2,130)=1.04	p=.357
Group	F(1,130)= .31	p=.578
Time by Group	F(2,130)= .31	p=.733

Digit Symbol

2(group) X 3(time) Analyses of Variance

Source	F value	p value
Time	F(2,129)= .23	p=.798
Time by Group	F(2,129)= .08	p=.924

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