To the Graduate Council:

I am submitting herewith a dissertation written by Harwell Fitzhugh Smith III entitled "Prediction and Observation of Sleep-Wakefulness Cycles and the Morningness-Eveningness Phenomenon." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.

Leo F. Droppleman, Major Professor

We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

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PREDICTION AND OBSERVATION OF SLEEP-WAKEFULNESS CYCLES AND THE MORNINGNESS-EVENINGNESS PHENOMENON

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Harwell Fitzhugh Smith III

August 1978

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DEDICATED TO

my wife, Marthanne Olivia Manion,

and friends, Lee Edwin Phares and

James Randolph Sheehan

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ABSTRACT

A study was designed with the twofold purpose of (1) describing Night and Day Persons in terms of time of going to sleep each weeknight and amount of sleep obtained each weeknight and (2) describing an Accurate Predictor Profile for predictors of time of going to sleep and of amount of sleep in terms of some characteristics of his/her behavior that might be related to sleep habits.

To this end the 34 subjects, 16 men and 18 women, with a median age of 23.5 were given a questionnaire which called for a prediction of Sleeptime on a weeknight, amount of sleep typically obtained per weeknight, responses on a number of items which a pilot study or the sleep literature suggested might be related to prediction of sleep habits and a statement as to the type of person (Night, Neither or Day) he/she considered himself/herself to be. Subjects then kept a record of their sleep pattern for a two-week period.

Night persons were found to have a later mean weeknight Sleeptime than Day persons and to obtain less sleep per weeknight. The datum from the pilot study that 12:45 a.m. is the mean Sleeptime that divides Days from Nights appeared to hold for this sample. A Kendall Rank Correlation Coefficient significant at the .034 level showed that persons do exist who are accurate predictors of both time of going to sleep and amount of sleep. Because the characteristics of this type of profile were not readily discernible, the investigator sought to discover a separate accurate predictor profile for each phenomenon.

Accurate Sleeptime prediction was related to (1) median age greater than the sample median, (2) using stimulants less frequently than the sample mean, (3) not smoking cigarettes, (4) having the same sleep schedule for a year or more, and (5) having most-active periods from 10 a.m.-Noon and 8 p.m.-10 p.m. Accurate Amount of Sleep prediction was related to (1) napping less than the sample mean, (2) using fewer sedatives than the sample mean, (3) not smoking cigarettes, (4) being less nervous than "many or most" people, and (5) having a most-active period from 10 a.m.-Noon.

It was concluded that the study's methods were effective but could be modified in the future to incorporate recently emerging findings in the field. The study's results confirmed some expectations based on the literature and pilot study but contradicted others. On the whole, the conclusions about Night and Day persons seemed more sound than those about accurate sleep habit predictors.

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CHAPTER I

INTRODUCTION

During my undergraduate years I had noticed that all group gatherings of my clique ended by 3 a.m. with myself the only person still awake. My explanation for the difference between myself and my compeers was that I was a Night person while the rest of the group were Day people. When I got to graduate school I began to consider how to demonstrate my intuitive conviction that two distinct types of sleeping habits occur in the population.

Before I could show that the types existed I would have to decide how to define a type. I wondered if what I had observed was evidence of a bimodal curve of time of going to sleep such that the Night person would be one whose time of going to sleep fell at or around the later mode with the Day person's time falling at or around the earlier mode. If this were true there might also be a bimodal curve describing differences between groups in the amount of sleep they obtained per night; expecting that the Night person would either get less sleep per night or wake up later than the Day person.

To give credence to my bimodal curve theory I would have to have a large sample of people whose reports on their sleep habits were certifiably reliable. It would be easy to ask a large number of people when each typically went to sleep and how much sleep each typically got. However, I would not be able to validate each person's impressions.

To have a reliable sample from which to establish my hoped for curve, I had to develop a way of assuring reliability of statements about sleep habits.

I resolved to find a way of distinguishing the accurate or reliable subject from the inaccurate one. What I came up with was an attempt to discriminate the accurate subject by his response to a number of questions which had been established as discriminating between the accurate declarer and the inaccurate one. This required that I formulate a list of questions which I believed would be discriminating, that I give these questions to a sample of people along with questions which required a statement of the sleep habits of each and that after receiving the completed questionnaire I then have the subject record his sleep habits during a prescribed period of time. Finally I would compare each subject's declaration of his habits with his observed habits such that a subject with a high congruence could be labeled an accurate declarer or predictor. A comparison among all predictors of their responses to the discriminating questions would then be undertaken to see what commonalities the accurate predictors as a group had in their replies on discriminating questions.

My investigation was successful in several respects. First, there did exist in my sample a continuum of accuracy of prediction such that part of the group could be labeled accurate predictors. I also found that the members comprising the subgroup of accurate predictors differed for sleeptime prediction, waketime prediction and predicted amount of sleep. Further, I found that a person's statement

of his person-type as Night or Day did correspond with an observed sleeptime later or earlier respectively than the mean sleeptime of the whole sample. I found that amount of sleep was less for the Night person than for the Day person but that actual time of waking up was the same for both types. Most importantly, I discovered that particular answers to certain of the questions did indeed discriminate between an accurate and an inaccurate predictor, though the questions that discriminated an accurate sleeptime predictor were in some cases different from those that discriminated an accurate waketime predictor and were again different from those that discriminated an accurate predictor of amount of sleep.

What I propose to do is replicate and extend the findings of this first study to the extent that when the study is finished I will have prepared a questionnaire that I can give to a large group of people which will (1) tell me what the sleep habits of each is and (2) offer me some assurance that the sleep habits each says he has are indeed the sleep habits he has. In order to accomplish these two ends I have designed a questionnaire on which the subject states both the sleep habits he has which I discovered to be relevant to his Type and his answers to questions about those habits which the first study showed to be relevant to his accuracy of statement. After filling out the questionnaire each subject keeps a record of his sleep habits. Finally I compare each subject's predictions of his habits with the sample of habits I obtain. An accuracy score for each person will thus be obtained and the subjects will be rank ordered according to this score. The

accurate subjects will be cross-compared to determine if the question responses found to be discriminators of the accurate predictor in the initial study hold as discriminators in this study.

CHAPTER II

REVIEW OF THE LITERATURE

Current State of the Evidence about the Ontogenesis, Existence and Nature of the Sleep-Wakefulness Cycle

In Sleep and Wakefulness (1963) Kleitman comments that,

> The existence of distinct ""morning"" and ""evening"" types is also an everyday observation among students particularly, some preferring to study late at night and sleep late in the morning, while others like to go to bed early and study early in the morning. As we were able to establish in some subjects, ""morning"" people have their temperature peaks early in the day, shortly before or shortly after noon, and the opposite, of course, applies to evening people.

Since Kleitman made this statement a great deal of research has been done both in the area of sleep-wakefulness cycles per se and their relationship to body temperature as well as in the area of morning and evening types of people.

It currently appears that there is no unitary phenomenon of sleep, as such. This was the conclusion of Weitzman and his coworkers in 1970 who noticed that the difference between baseline and experimental conditions, in a study of acute reversal of the sleep-wakefulness cycle, varied within each stage suggesting that each sleep stage might result from and contribute to something unique in the organism. Kleitman (1969) has proposed the Basic Rest-Activity Cycle (BR-AC). According to Kleitman (1969), Weitzman et al. (1970) and numerous other workers, there exists in the human organism a 90 minute cycle wherein the organism reaches an activity peak every 80-100 minutes. Kleitman (1969)

notes that this period changes in length with age; being only 50-60 minutes in the human infant. He further notes that Rapid Eye Movements (REM's) do occur in a sleeping subject at the peak of the Basic Rest-Activity Cycle along with other manifestations such as heart and respiratory rate changes, contraction of small muscles around the head and simultaneous relaxation of other muscle groups. Weitzman, Kripke, Goldmacher, McGregor and Nogeire (1970) have noted that "basic 90-100 minute cyclicity was preserved following acute inversion to day sleep." Sterman (1972) has carried Basic Rest-Activity Cycle research even further to the point of hypothesizing that the Basic Rest-Activity Cycle and the sleep mechanism may be different mechanisms with the Basic Rest-Activity Cycle going on 24 hours a day. This would fit with Hartmann et al.'s (1971) idea that stage 3 and 4 sleep is physically restorative while REM sleep has the different function of being psychologically restorative. Further it may offer an explanation for why long and short sleepers have equal amounts of stage 3 and 4 sleep but widely varying amounts of REM sleep. That is, according to Hartmann et al. (1971), all types of people probably have about the same need to be physically revitalized while varying greatly in their need to be psychologically revitalized. It also suggests that one reason REM sleep so resembles the waking state (it is called paradoxical sleep for this reason) is because indeed the subject is almost awake (as we know that REM's occur when the subject is in Stage 1 sleep) with respect to the sleep mechanism. Sterman (1972) proposes that the Basic Rest-Activity Cycle goes on even when we are awake and that activity peaks correspond to REM appearances

when the person is asleep or awake. Globus, Phoebus and Moore (1971) showed some evidence that Vigilance while awake improves at a time when REM's would be occurring if the subject had stayed asleep. At this point it may also interest the reader to know Webb and Agnew's (1967) conclusion that EEG's of naps resemble the most proximal longer sleep period with respect to Stage 4 and 1 REM sleep. This bit of data suggests that some regulatory factor of the sleep mechanism also runs 24 hours a day either because it is the same as the Basic Rest-Activity Cycle or because it exists separate from but alongside the Basic Rest-Activity Cycle, or because both are under the influence of a third variable. At this point we should also note Dement and Wolpert's (1958) conclusion that, "whereas the eye movements [REM's] seem to be specifically related to the dream imagery, body movement does not," and "eye movements are apparently controlled from different cortical areas than most other movements." This conclusion suggests again that the Basic Rest-Activity Cycle, as manifested by REM cycle, and the basic sleep-wakefulness cycle are different entities.

The Nature of the Sleep-Wakefulness Cycle

Having read the preceding paragraphs the reader will understand the hazards of discussing the "Sleep-Wakefulness Cycle." That is, it currently appears that a discrete division may not exist between sleep and wakefulness, further, that sleep itself is probably not a unitary phenomenon and finally, that the sleep-wakefulness cycle may be two or more cycles occurring contiguously. Given all these qualifications,

it is possible to summarize the information which describes the sleep-wakefulness cycle.

In 1953 Kleitman and Engelmann published a study of sleep-wakefulness patterns in infants in which they graphically depicted the change in the sleep-wakefulness cycle over the first 6 months of life from a polycyclic (that is apparently randomly occurring periods of sleep) phenomenon to a monocyclic one. Hellbruegge (1960) offered further graphs of cycle development from infancy to adulthood. It was Halberg (1960) who first made extensive use of the word "circadian," meaning approximately a day, in describing the sleep-wakefulness cycle in humans. However, he was by no means the first to speculate on the origin and maintenance of the 24-hour periodicity of sleep and wakefulness. Two quotes from Kleitman show the change in understanding of the circadian periodicity of sleep-wakefulness over the past 50 years. In 1929 Kleitman stated, "Diurnal alternation of wakefulness and sleep is a 'conditioned' phenomenon" (p. 655). In 1967 he concluded "It appears that the individual circadian periodicities of unknown endogenous origin, are obscured by the establishment and maintenance of the customary 24-hour sleep-wakefulness rhythm" (p. 34).

Kleitman seems over the years to have increased his appreciation for endogenous factors in sleep-wakefulness rhythms and indeed the evidence at present suggests the degree to which the periodicity is an effect of one or the other influence may vary from person to person. Aschoff (1954) used the term Zeitgeber (literally "time givers") to describe exogenous influences such as tide cycles and light-dark cycles

on circadian periodicities. Among the studies which confirm that external variables do influence circadian periodicity is that of Bonjer (1960) who showed not only that it takes time for body temperature cycles to shift in adaptation to a change from day working to night working but also that the number of days this shift takes varies with the subject (1, 2, or 3 days in his study). Hauty and Adams (1966) showed that East-West translocation across seven time zones resulted in subjects requiring several days to return to baseline functioning on the variables of rectal temperature (4 to 6 days) and heart rate (6 to 8 days). The reader will notice that the different physiological aspects studied took different lengths of time to make the shift. These studies offer fairly certain evidence that an endogenous periodicity exists which can be affected by external variables, that there exists more than one circadian periodicity in any single person and that the degree to which a particular circadian rhythm is internally or externally maintained is some function of the individual in which it occurs.

Studies which treat the question of degree of internal and/or external maintenance of the sleep-wakefulness circadian rhythm in particular are again the province of Nathaniel Kleitman. In 1953 Kleitman and his family spent time together in isolation in Norway in an attempt to gauge the degree of adaptation of oral temperature and heart-rate each would display to artificially imposed 18 and 28 hour sleep-wakefulness cycles. In this case, as in his famous 1938 Mammoth Cave study (1963, pp. 1978-1982), where he and a coworker attempted adaptation to a 28 hour routine, Kleitman himself was unable to break from his 24 hour

periodicity while his cohorts adapted easily to the artificial routine. Adaptation or lack thereof to the 28 hour routine was a matter of subjective as well as objective experience for Kleitman and his coworker in the Mammoth Cave experiment. The coworker, R., had no difficulty falling asleep and no early awakenings and his body temperature troughed always and only while he was asleep. Kleitman on the other hand had difficulty falling asleep and frequently woke up too early. He noted that only when his body temperature trough coincided with a sleep period did he sleep well.

Changes in latitude, season of the year and climatological factors have been related to change in sleep-wakefulness cycles. Simpson and Bohlen (1975) concluded from a study of Eskimos that oral temperature amplitudes are greater in higher latitudes. While this is not directly relevant to S-W cycles it is included here as a warning that the physical location in which S-W research is done may limit the generalizability of the findings. Horne and Coyne (1975) found that time of peak oral temperature varies more than an hour from December to June. This suggests one must be careful when comparing oral temperatures of morning and evening groups in one study with those in another that one has made necessary correction for the studies being done at different times of year. Horne and Coyne (1975) also concluded that the oral temperature of females rises more slowly in June than in December or March. This was not true of the male subjects. Such a conclusion suggests researchers studying body temperature of groups of morning and evening people on the assumption that these temperature

curves reflect some physiological difference of type should be careful either that both groups have equal proportion of females or that both groups are each broken down by sex. A final interesting, though possibly unrelated, factor in the sleep-wakefulness cycle is suggested by Cloudsley-Thompson's (1956) study of "humidity responses and nocturnal activity in Woodlice." Cloudsley-Thompson concluded that "degree of nocturnal activity is correlated with ability to withstand water loss by transpiration." What he found was that those species of woodlice most prone to drying out were also most prone to expose themselves to the elements only after dark. One purely speculative conclusion one might draw from this is that evening people may exhaust water from the body by perspiration and/or urination more frequently, readily or in larger quantities than do morning types.

While it is Kleitman's (1963, p. 184) conclusion that the 24-hour sleep-wakefulness periodicity "is based on a combination of nervous (probably cortical) and endocrine (probably hypophyseal-adrenocortical) individually acquired mechanisms," it is apparent that the sleep-wakefulness cycle is somehow linked to the body temperature cycle such that body temperature troughs usually coincide with being asleep and body temperature peaks usually coincide with alertness or efficiency peaks.

The Natural Occurrence of Sleep and Some Related Factors

Having examined the sleep-wakefulness cycle it now seems important to give some data on the natural occurrence of sleep in the population

as well as some information on factors presently known to effect the phenomenon of sleep. Amounts of sleep commonly taken will be the first subject considered followed by a brief look at how the factors of age and gender affect sleep. Finally the conclusions of miscellaneous studies related to sleep will be mentioned.

Research supports the widely held assumption that 7-8 hours is the normal sleep requirement for most adults. In their cross sectional study of 2,446 subjects age 15 to 75+, McGhie and Russell (1962) found that 62% slept 7-8 hours, 15% slept 5-6 hours, 13% slept 9-10 hours and 10% slept less than five or more than 10 hours. Tune (1968) has established in a longitudinal study of 240 subjects that the amount of sleep an average person gets declines steadily from his 20's to his 50's only to increase during his 60's and then drop off again in his 70's.

Age effects are commonly found in the sleep literature. Tune (1968) found that frequency of midday naps increases as age increases. The "early to bed early to rise" habit also increases as age increases according to another Tune (1969) study.

Feldman (1970) found that college students' average bedtime is 12 midnight. Such a late hour is congruent with Tune's "early to bed" findings. Kleitman (1963, p. 182) suggests that degree of adaptability of sleep schedule to changes in zeitgeber may be a function of age with older persons finding adaptation harder.

Gender differences in sleep habits are the most commonly found types of differences. Tune (1968) found that women sleep less than men. Feldman's (1970) findings that college women awake 20-30 minutes earlier

than college men is congruent with Tune's finding. Strauch and Wollschlager (1973) found that older women (over 65) sleep less than older men. Strauch and Wollschlager and Pleimes (1973) found women go to sleep later than do men. Tune (1968) also found that women awake more frequently during the night than do men; a confirmation of the findings of McGhie and Russell (1962). Other sex differences which emerged from McGhie and Russell's (1962) landmark study but which are yet unconfirmed are: Women change their sleep pattern earlier in life than do men, women's use of hypnotics increases with age, more women than men reported being nervous and tired during the day, women reported light sleep in more cases than men and women reported increases in presleep difficulties with increasing age.

Factors thus far uncited that have been found to effect sleep are mentioned here for completeness. Pleimes (1973) reports in a brief abstract that subjects with a regular work regimen slept less than those without. Lewis (1961) and Lewis and Masterton (1957) found that there was no relationship between number of sleep interruptions and number of naps in any given subject. Hollingworth (1912) found that most people must take in at least 388 mg. of caffeine during the day to experience sleep disturbance on account of caffeine; a cup of coffee contains between 100 and 150 mg. of caffeine. He further found that there is more effect if the caffeine is taken continuously and that there is no effect if caffeine is taken only with lunch. As with most drugs, Hollingworth found that susceptibility to caffeine decreased as weight increased.

Types of Sleepers

Having discussed sleep-wakefulness cycles and factors which affect or are related to sleep it now seems important to discuss the distinctions which have been made between groups of people on the basis of their sleep habits. Hartmann and his coworkers (Hartmann 1973a, 1973b, Hartmann, Baekeland, Zwilling & Hoy 1971, Hartmann, Baekeland & Zwilling, 1972) and Webb and his associates (Webb 1965, Webb & Friel 1970, 1971, Webb & Agnew 1970) have researched "natural" long and short sleepers. Wittstock (1933) and Rieper (1934) describe the morning sleeper and evening sleeper while Janz (1962, 1974) has discussed the correlation between types of epilepsy and types of sleepers. Studies which will not be discussed here but which the interested reader may seek out are those of Monroe (1967) on good and poor sleepers and Sheldon (1942) on the Viscerotonic and the Cerebrotonic temperament as related to sleep habits. Definition of these various types of sleepers include some or all of the variables of observable differences in hour of sleep and sleep habits, physiological differences and psychological differences. The results of the studies cited above are presented by sleeper type. While it is tempting to believe all the following studies could be integrated into a single dimension of sleeper type, the evidence is as yet too contradictory and incomplete to allow such a synthesis.

Long and Short Sleepers

The "long sleeper" is usually a person who naturally takes more than nine hours of sleep per night (Hartmann, Baekeland & Zwilling 1972).

However, it is generally agreed that 7 to 8 hours per night is the sleep requirement of most people and sleepers have been judged to be "long" when they sleep more than 8 hours (Hartmann 1973a) and only when they sleep more than 9.5 hours (Webb & Friel 1971). The "short sleeper" is usually one who sleeps less than 5.5 hours per night (Hartmann 1973a, Webb & Friel 1971) though occasionally the line is drawn as high as 6.5 hours (Webb & Agnew 1970) and as low as below 5 hours (Hartmann, Baekeland & Zwilling 1972). In a cross sectional study of 2,446 people age 15 to 75+, McGhie and Russell (1962) found that 8% slept less than five hours and 15% slept more than nine hours. In general the data of Hartmann et al. are probably more generalizable to the adult population than are the data of Webb et al. because as Hartmann et al. (1972) noted, and as other research tends to support, sleep patterns are not stabilized until age 17 to 20. Webb tends to use subjects in this age range while Hartmann generally uses subjects older than 20.

Hartmann (1973a) and Hartmann et al. (1972) concluded from studies that the short sleeper is inclined to be a busy, efficient person who uses stimulant pills while the long sleeper scores higher on the California Personality Inventory Neuroticism scale, may be more creative and does not use stimulant pills. Hartmann states that the short sleeper is "preprogrammed" to societal convention while the long sleeper is constantly "reprogramming." Both groups get the same amount of short wave (deep) sleep but the long sleeper gets twice as much dream sleep (Hartmann et al. 1971). This is where Hartmann proposes the reprogramming takes place. It is probably important to insert that

Hartmann et al. (1971) suggest that short wave sleep is the physiologically restorative aspect of sleep. This would account for its being the same absolute amount in both long and short sleepers and it would explain Baekeland and Lasky's (1966) findings that percent of stage 3 and 4 sleep increases as against total time slept with presleep physical exercise. It should be noted that Webb and Friel (1970) found no differences in psychological adjustment between long and short sleeping college freshmen. Other conclusions of Hartmann et al. (1971, 1972) which may become relevant in the explication of our study were that long sleepers had twice the sleep onset latency (34.4 min. v. 17.1 min.) and went to sleep earlier than the short sleeper.

Evening and Morning Sleepers

Wittstock (1933) quotes Aschaffenburg (1908) in German as describing the evening and morning type of sleepers. The evening sleeper has no trouble falling asleep, reaches his greatest sleep depth after 1-2 hours and awakens immediately ready to work. The depth of sleep tapers off rapidly and then plateaus. Rieper (1934) quotes Winterstein (1932), also in German, as reaching conclusions virtually identical to Aschaffenburg's. The morning sleeper cited by these two men falls asleep much later than the evening sleeper, has his deep sleep distributed throughout the night and reaches his greatest sleep depth late in his sleep cycle.* A study which appears to support the German conclusion

*The reader should note that this writer has not read the original reference nor does he know anything about the quality of the studies from which these conclusions were drawn.

comes from Johnson and Wiegand (1927) who measured body movement of sleepers. They found that while most of the sample of 18 reached their quietest period within 1.5 hours of retiring, "One, at least, rests more quietly after 7 hours in bed than at any other time and two others almost as quietly then as in the early hours" (p. 47).

Types of Epilepsy and Types of Sleepers

Janz (1962, 1974) describes the sleep habits of the awakening epileptic (who has his seizures immediately after awakening) and the sleep epileptic (whose seizures are immediately after going to sleep and immediately before awakening). The awakening epileptic as described by Janz looks very much like the morning sleeper earlier discussed insofar as he is most active in the afternoon, falls asleep late and with trouble and reaches his greatest sleep depth after four hours. In addition he has trouble getting up in the morning and spends more time in REM sleep than does the sleep epileptic. The sleep epileptic, like the evening sleeper, falls asleep and wakes up early, is tired in the late afternoon, and reaches his deepest sleep in 1.5 hours. In his earlier article (1962), Janz goes so far as to describe variation in physique of the two types and to note that onset of vocal change at puberty begins early (13-15) in the awakening type and later (after 16) in the sleep type. No gender differences are noted in either of these studies.

Relationship of Body Temperature to Morning and Evening Types of People

The ensuing discussion will attempt to demonstrate to the reader that there are distinct morning types and evening types of individuals which differ in various ways from one another. It will be seen that the chief behavioral differences appear in terms of sleep habits and efficiency levels while the chief physiological differences are in terms of body temperature rhythms.

While Tune (1969) correlated extroversion-introversion with sleeping habits, as mentioned earlier, Blake (1971) was the first researcher to correlate the physiological variable of body temperature with a related dichotomized psychological variable; again introversion-extroversion measured by the Heron Personality Inventory Scale. Blake graphed body temperature curves for introverts as a group and extroverts as a group and concluded that the peak temperature for introverts occurred at 1830 hours while for extroverts the peak time fell at 2030 hours. Other data which related to the I-E distinction was Blake's evidence that introverts have higher arousal levels in the morning than do extroverts and that arousal level increases at a greater rate in extroverts such that until 3:00 p.m. the introverts output level is higher than that of the extrovert except from 10:30-11:30 a.m. After 3:00 p.m. however the extrovert's output level is much higher than that of the introvert.

Horne and Ostberg (1976), using a modified version of a questionnaire designed by Oquist (1970) were able to isolate extreme morning and

evening types of individuals and compare the body temperature curves of the two groups. These authors found that the morning group of individuals had a body temperature peak at 1932 hours B.S.T. (British Summer Time) while the evening group showed a body temperature peak at 2040 hours B.S.T. (British Summer Time is one hour ahead of Greenwich Mean Time.) An earlier study by Ostberg (1973a), using a different modification of Oquist's questionnaire, found large differences between peak body temperature times for morning and evening groups. This study was of questionable value however as body temperature was only measured at four prespecified times of day. However, Horne and Ostberg's (1976) results combined with Kleitman's (1963) conclusion that his sleep was only good when it corresponded to a body temperature trough suggest both that body temperature is an important variable in the sleep-wakefulness phenomenon and that at least one way of behaviorally identifying "morning" and "evening" types of individuals has some basis in physiological differences between types.

Behavioral differences between individuals on a number of variables allowed Horne and Ostberg (1976) to describe morning and evening types of individuals. The evening type of individual fell at the opposite end of a multiple choice scale for each item from the morning type described here. The morning type of person freely chose an early arising and bed time, did not need an alarm clock to awaken, arose readily from sleep and was immediately alert, experienced hunger and little tiredness during the first half-hour after awakening, noted little difference between his free choice bedtime and his externally

imposed one, estimated subjectively that his performance quality on physical tasks was good in the early morning and poor in the late evening, had an earlier time of day of feeling in need of sleep than did the evening person, subjectively estimated that his mental peak hour fell early in the day, had an extremely high degree of tiredness at 2300 hours, estimated he would be likely to arise at his regular time even after going to bed several hours later than usual, would sleep predominantly before 0400 hours if he had a job requiring him to work from 0400-0600, would choose 5 consecutive hours early in the day that he would prefer to work if free to choose his own 5 hours, had a "feeling best" peak hour earlier in the day than the evening person and described himself as a morning person.

Ostberg's Hypothesis

In 1973 (a) Ostberg hypothesized that morning type people have an autonomous 24-hour periodicity while evening type people seem to be entrained into a 24-hour periodicity from a longer one. Evidence to support this theory is provided by Ostberg and others. Ostberg (1973a) refers to Wever's (1969) study showing that body temperature peak occurs in the middle part of the active period in those individuals who are "locked on" to a 24-hour period while subjects living totally isolated from zeitgeber get "free floating circadian rhythms with, on average, a 25-hour periodicity with temperature maxima in the later part of the active period." Ostberg does not say whether all of Wever's isolated subjects developed 25-hour periodicity, however, evidence from

Kleitman's (1963) Mammoth Cave study and his (1953) study seem to confirm that some people continue on a 24-hour periodicity when 24-hour zeitgeber are removed while others are more or less completely dependent on the zeitgeber for maintaining the 24-hour periodicity.

Hartmann's conclusion about long and short sleepers also support Ostberg's hypothesis. In 1973 Hartmann hypothesized that the short sleeper was "preprogrammed" while long sleepers were "reprogramming." What he meant by this is that the short sleepers seemed to have a fairly standard daily routine which did not include worrying about themselves, politics, or life situations; they were conventional. The long sleepers, however, did worry about themselves, politics, etc. and seemed to spend a good deal of time daily turning over old concepts and adapting them to new information. These observations acutely fit Ostberg's autonomous/entrained hypothesis about morning and evening people.

Ostberg himself (1973b) provides other study results which support his hypothesis. With a modified version of Oquist's (1970) morningness-eveningness questionnaire he was able to separate shift workers into types and then determine ease-of-adaptation to a shift change for each group. He found that evening types had the least difficulty adapting to the change while morning and middle types had about the same difficulty. Ostberg manipulated statistical data from a number of different measures to come up with this conclusion which may be challenged on the grounds that a difference requiring so much manipulation in order to be seen may be an inconsequential difference. The reader

should consider his conclusion with a critical eye. However, according to Ostberg's hypothesis we would expect that evening people would adapt more easily to shift changes than morning people because their adjustment to sleep-wakefulness periodicity is less endogenously controlled and therefore more readily influenced by zeitgeber than is the periodicity of the morning types.

Two questions which appear on Horne and Ostberg's (1976) morningness-eveningness questionnaire offer further support for Ostberg's hypothesis. They asked the respondent when he would wake up, relative to his normal waking time, if he had gone to sleep several hours later than usual and was not required to wake up at a particular time. They also asked to what extent the respondent was dependent on an alarm clock for waking up at a particular time. Weights of the multiple choices on both questions were in the direction of the evening person being dependent on zeitgeber to wake up while the morning person would arise autonomously. The authors found these two questions to be discriminative of evening from morning types of people when included with the other questionnaire items.

Literature on Methods Used in the Study of Sleep Habits

Sleep as a behavioral phenomenon can be studied latitudinally in a one-shot sampling of a large number of people, generally by means of a questionnaire. It can also be studied longitudinally, generally by means of a record form upon which the subject records his sleep habits

continuously for some number of days. The variables that have occurred on questionnaires are considered below followed by an examination of commonly found characteristics of longitudinal sleep records.

Perhaps the most widely occurring question on sleep habits has to do with the subjects' habitually obtained amount of sleep. McGhie and Russell (1962), Hartmann et al. (1972), Monroe (1967) and Strauch and Wollschlager (1973) have all requested this information as did Smith (1976). Hartmann and his coworkers (1972) also included questions on whether or not the subject needed to "catch up" on lost sleep, what time the subject had to go to bed in order to feel fully awake the next morning and whether or not the subject was being treated for a medical illness. Questions strictly on drug and/or medication use came from Hartmann et al. (1972) and Smith (1976) who sampled stimulant and sedative use and from McGhie and Russell (1962) who requested information on hypnotics use only. Monroe (1967) and Smith (1976) asked subjects whether they typically slept alone or with another person. Frequency of occurrence of naps was a subject sampled by Monroe (1967), Strauch and Wollschlager (1973), Smith (1976) and Pleimes (1973). McGhie and Russell (1962) asked for the subjects' typical time of going to bed and to sleep, waking up and getting up. Smith (1976) also requested these figures while Strauch and Wollschlager (1973) wanted only the time of going to sleep and of waking up. Nervousness was sampled by McGhie and Russell (1962) while Pleimes (1973) sampled subjects "neuroticism." McGhie and Russell (1962) are the only researchers to sample subjects' social class while Strauch and

Wollschlager are the only researchers to request responses on items about sleep disturbances and usual quality of sleep.

Accurate sleeptime prediction was shown in the Smith pilot study (1976) to be associated with six factors. The accurate sleeptime (i.e., Time of Going to Sleep) predictor was one who (1) was female, (2) had a typically most-active period during the day of 2 p.m.-4 p.m., (3) said he/she slept more than once in the same day at least once a week, (4) averaged consumption of more than the sample mean of stimulants in a typical day, (5) averaged consumption of more than the sample mean of sedatives in a typical day, and (6) described herself/himself as a Night person. The accurate predictor of amount of sleep in the pilot was one who was (1) older than the median age, (2) a Night or Neither type person and (3) averaged a daily sedative consumption higher than that of the sample mean. The importance of these variables to a person's sleep habits was realized by Smith through the use of a questionnaire and sleep record.

Lewis' (1961) and Lewis' and Masterton's (1957) studies on sleep in the Arctic Circle have provided sleep researchers with a record form of reference in sleep research. These workers designed a sleep card which was comprised of a month of days with instructions to the subject to draw a line through each hour segment during which he was asleep. On Lewis' and Masterton's (1957) card, midnight was in the middle of each row of hour segments making up a day. The date was at either end and staggered such that any given row had one date at the beginning of the row, passed midnight in the middle, and had the next date at the end

of the row (see Figure 1). Tune (1968) put the date at the beginning of the row and had noon in the middle such that each row corresponded to a single calendar day. He also divided the day into half-hour segments (see Figure 2). Masterton (1957) included a section on the card for "days activity and place." "Remarks" sections were also included on the record form of Tune (1968, 1969) and Ostberg (1973b).

While, as mentioned earlier, Lewis' and Masterton's (1957) record encompassed 30 days, the trend has been towards a 14-day record as seen in the studies of Tune (1968, 1969), Ostberg (1973b) and Hartmann (1972). In a comparison of accuracy with length of record to discover how much shorter the period could be without significantly detracting from the representativeness of the results, Smith (1976) found that a recording period of greater than one week but less than three was optimal. Additional support for a two-week recording period comes from a study by Webb and Agnew (1970) in which a two-week recording period was used in helping discriminate between long and short sleepers.

A Remarks section proved helpful in analyzing data from the Smith (1976) study and one by Tune (1969). Admonitions to the subject to leave a day blank rather than guess have been included in instructions to subjects by Tune (1969) and Smith (1976). This admonition is one partial way of attempting to improve the reliability of the method of having subjects record their own sleep habits.

In this regard, Tune (1968, p. 270), remarked that, ". . . the validity of self-recording as a means of collecting data on sleep and

NAME Hamilton.... MONTH October 1953

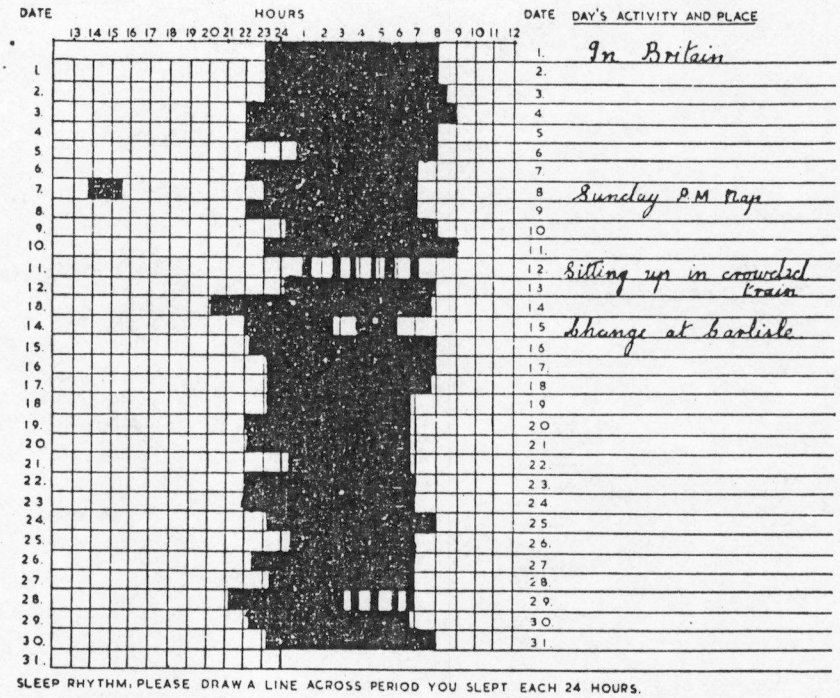


Fig. 1—Sleep-card. This shows the typical distribution of sleep during a month for a man in the U.K.

Figure 1. Sleep Record Form from Lewis and Masterton (1957).

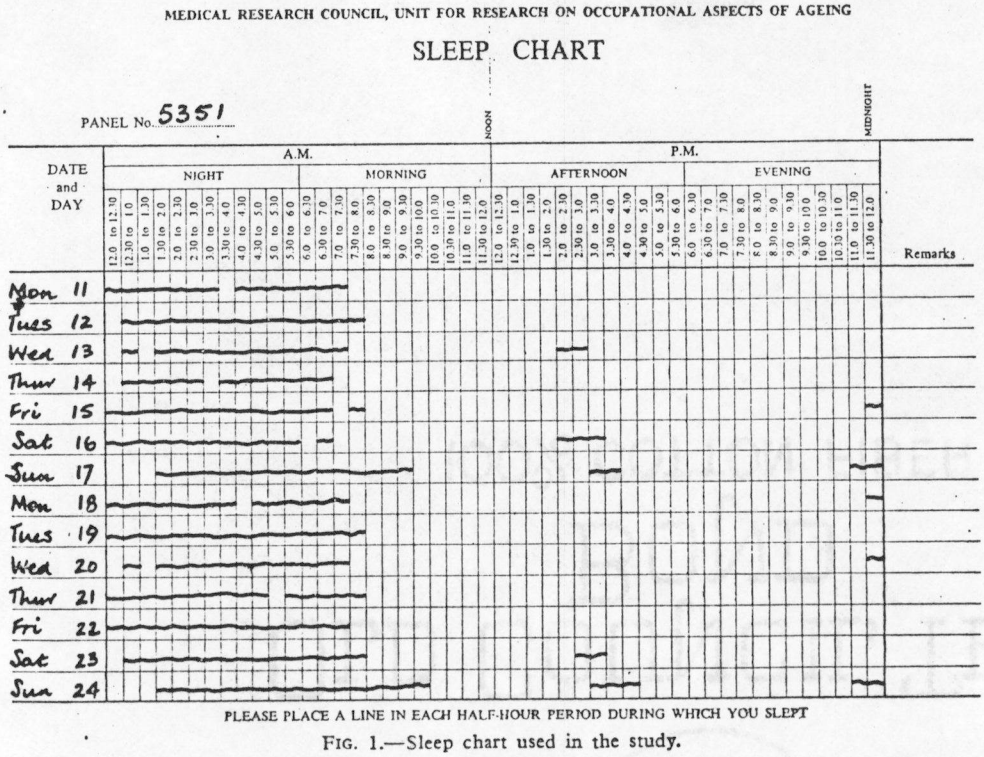


FIG. 1.—Sleep chart used in the study.

Figure 2. Sleep Record Form from Tune (1968).

wakefulness must remain an open question, though it is probably as reliable as any other subjective method. . . ." In a later study Tune (1969, p. 439) concludes that, "the importance of comparing objective and subjective records in order that accurate data may be accumulated is obvious but until other methods become more readily available, subjective methods will still find a place among the scientist's repertoire of techniques." As a final note, Lewis (1961) did not question the validity of self-report of sleep habits (perhaps because his subjects had little to do but record sleep habits) but, without saying how he arrived at the conclusion, he did remark that, "if one wished to achieve a recording accuracy better than a quarter of an hour it would be necessary to have individual supervision or use a specially constructed bed."

These remarks suggest that what is needed in the researching of sleep at this point is a way of validating information obtained about sleep habits in a cross-sectional study. Perhaps the best way to achieve this validation would be to follow-up the cross-sectional sampling of sleep habits by questionnaire with a period of recording each subject's sleep such that each subject's accuracy at describing his sleep habits can be known. Once this information has been obtained the characteristics of accurate describers can be assessed such that, in future cross-sectional studies, only the data provided by subjects fitting an accurate describer profile need be considered. One of the major thrusts of the study to be described was to establish just such an accurate-describer profile using information gained from the

Smith (1976) study on relevant variables as well as modifications of the questionnaires and records described above. At the same time, items were included on the questionnaire which the earlier review of the morningness-eveningness literature suggested might be relevant to this dimension in hopes that while furthering the cause of precision in methodology of studying sleep habits we could also learn more about the "morning person" and the "evening person."

CHAPTER III

METHODS

Subjects

In hopes of getting thirty subjects who would eventually complete the whole investigation we had forty subjects begin the study. Subjects were secured by a variety of means. The primary contact route was an advertisement run in the UT Daily Beacon every day for a week. This advertisement read as follows:

> Are you a Night Person, or a Day Person? Are you interested in finding out more about your sleep habits? My doctoral research can tell you more about these. If you're interested in sleep and want to know more about your own sleep habits call me about being a subject in my brief but thorough dissertation research: Harwell Smith, 525-6717, any evening this week from 6-9 p.m. I'll describe the study over the phone and, if you wish, arrange for your participation in the study.

Other modes of contact were:

1. A large poster with the above information was placed in a prominent place in the University Center;
2. A copy of the Study Description (Appendix C) was placed on the undergraduate psychology subject sign-up board; and
3. Volunteers were solicited from among my own friends and acquaintances.

Once contacted each subject agreed to one time or another of several offered at which he attended a group meeting for further explication of and initial involvement in the study. Subject solicitation was ceased after twenty subjects of each sex had agreed to attend one of the

meetings. Students were used as subjects both because they are easy to find and because, having somewhat more personal choice about sleep habits than the working person, their sampled habits might be more natural than the habits of people shaped by long-term commitment to a regular work routine. The final sample evaluated was comprised of 34 rather than 40 subjects because the investigator felt it was important to avoid considering coworkers and relatives who had prior knowledge of the purposes of the study.

Measures

The measures to be taken from this study correspond closely to those established in the initial study. There were two self-report measures used in the study. The first of these is a questionnaire about the subject's sleep habits and the second is a form for recording sleep habits (see Appendices A and B).

The questionnaire solicited subject response to the following: (1) time of going to sleep on a typical weeknight, (2) amount of sleep obtained on a typical weeknight, (3) the two two-hour periods per day when the subject was most active, (4) the number of days in a week that the subject sleeps more than once a day, (5) the average number of stimulants the subject takes in a day, (6) the number of hours before bedtime he/she takes his/her last stimulant, (7) the average number of sedatives the subject takes per day, (8) the estimated number of cigarettes he/she smokes per day, (9) the subject's self-description as a Night, Day or Neither type person, (10) the length of time he/she

had had the same sleep schedule, and (11) his/her subjective estimate of his/her degree of nervousness relative to the population.

The questionnaire solicited responses in two areas: (1) the subject's sleep habits with regard to variables used to define Night or Day type persons and (2) the subject's sleep habits with regard to variables used to define an accurate predictor of time of going to sleep and amount of time slept. Waketime was dropped from this study because of the pilot study finding that there was little variation in obtained waketimes between Night and Day groups.

The format of the sleep record is taken from Tune (1969) with modifications. He in turn used a modified version of the record employed by Lewis (1961). The record requires the subject to draw a line through each 15 minute period during the day in which he sleeps more than 7.5 minutes. Subjects kept the record for 14 days. Fifteen minute periods are used for reasons discussed in the literature review.

The reader will notice that the subject is asked to note any of a number of specific events/states in his/her day and is further admonished to include in the section, "anything else he/she believes might have affected his/her sleep cycle that day." The specific items suggested are ones which have been shown either in the literature or in subject responses from and after the pilot to have had an effect on the sleep cycle. Solicitation of extra item input from the subject is included in an effort to involve the subject in thinking about the record and thereby contributing to the study of sleep-wakefulness cycles both in this study and in general. It was found from the pilot study

that, if subjects are not asked on the record to include specified and unspecified intervening variables in the Remarks section, they tend to ignore the section. Having accomplished an explication of the measures used in the study and how these will answer the research questions, the final step required is an explanation of the procedures followed in the study.

Procedures

Three meetings were held at each of which the same procedure was followed. First the investigator described the study per Appendix C. Subjects were informed that the study would require about 30 seconds per day for 14 days after the initial meeting and finally would involve their returning their records to me and participating in an optional debriefing. Subjects obtained through the Beacon ad were given this information over the phone. After this introduction at the meeting the investigator assured the subjects they could quit at any time and, in the case of volunteers for credit, receive full credit for their participation. Next, the investigator answered questions about the field and the study itself and displayed the questionnaire and record that were used in the study.

After this the subjects were asked to sign the consent form (Appendix C). As stated in the consent form, each subject was assigned a subject number which never appeared in conjunction with his/her name. Next, each subject filled out the questionnaire and returned it to the investigator. The investigator then paired each subject with a graduate

assistant at the meeting from whom the subject received his record form and with whom he arranged a place to keep the form so that it was visible and accessible to him throughout the recording period. Each graduate assistant had a checklist of items to cover with each subject. This checklist included:

1. A decision about where the record would be posted,
2. A decision about when the subject would make his notations with emphasis on choosing a time shortly after awakening,
3. A discussion of the notes at the bottom of the record to be sure the subjects understood those and comprehended their importance,
4. A reminder to the assistant to fill in the day and date for each day in the recording period on the form, and
5. A reminder to make clear to the subject that he should draw a line through each quarter hour interval during the recording day in which he was asleep for more than 7.5 minutes.

Finally, each subject was informed that he would receive a phone call from his graduate assistant or the investigator within the first three days of his beginning the record. This contact was made to answer questions that might have arisen after the trial period began. In addition the subject was told to expect a call at the end of the first week of the period for the same reason. Finally, the subject was informed about the time and whereabouts of the debriefing meeting.

CHAPTER IV

RESULTS

The data on Night, Day and Neither persons yielded clear though sometimes overlapping conclusions about the nature of each type of person. As regards the qualities of the accurate predictor it was found that accurate predictors of Time of Going to Sleep and Amount of Sleep were significantly correlated but differed on several of the variables studied. A description and analysis of the observation will make the differences and similarities clear.

Sleep Habits of Types of Sleepers

The most active periods of the day varied on an apparent continuum between types of sleepers. Night people (N=13) had the latest times at 6-8 p.m., 8-10 p.m. and 10 p.m. to Midnight with Neithers (N=10) significantly earlier, 10 a.m.-Noon and Noon-2 p.m., and overlapping the Day types (N=11) peaks of 8-10 a.m. and 10 a.m.-Noon (Figure 3).

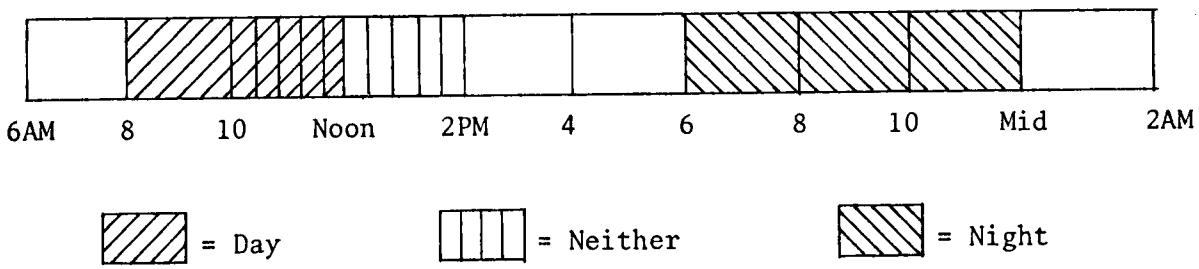


Figure 3. "Most Active" Periods.

Amount of sleep obtained on a typical weeknight varied in the same way. Night persons obtained 7 hours and 13 minutes sleep on the average weeknight. Neithers were in the middle but close on the Night end of the continuum this time at 7 hours and 15 minutes while Day people slept a significantly longer 7 hours, 29 minutes (see Figure 4). Typical time of going to sleep on a weeknight was 1:23 a.m. for Night people, 1:11 a.m. for Neithers and 12:15 a.m. for Day Persons (see Figure 5 for this data). Again we see the tendency of Neithers to closely resemble Night persons. It is interesting to note here that 73% of the Day persons have a weeknight Sleeptime earlier than 12:45 a.m. while 85% of the Night persons have a Sleeptime later than this same time. Eight of the ten Neither types fell on the Night side of the discriminating time. On the variable of subject age the Night person's average age was 22 while for the Neithers it was 22.5 and for the Days, 25. The Night, Neither, Day continuum held up for gender differences as well. Night persons were 9 to 4 females to males with Neithers being equally divided and Day persons being 7 to 4 males to females (see Table 1).

The number of naps an individual averaged was not significantly different between Night and Day groups. However, Neither persons did average notably fewer naps than either of the other groups. Just as a note, it was found that the average number of naps predicted by the Day group was identical to the average number they obtained. This was not true of the other two groups though again the Neithers fell in the middle on accuracy of prediction of this factor. A nap was any period

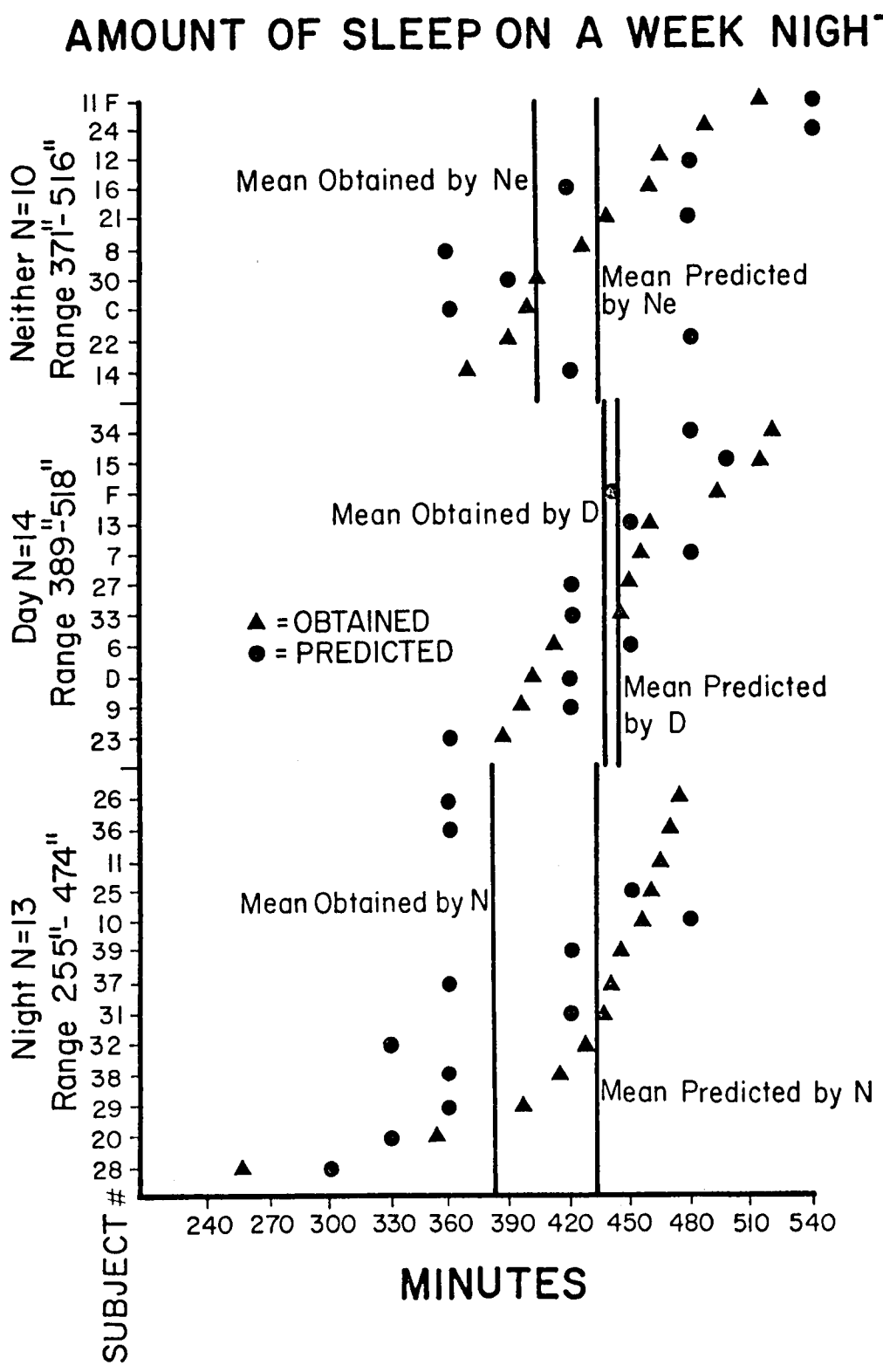


Figure 4. Amount of Sleep on a Weeknight.

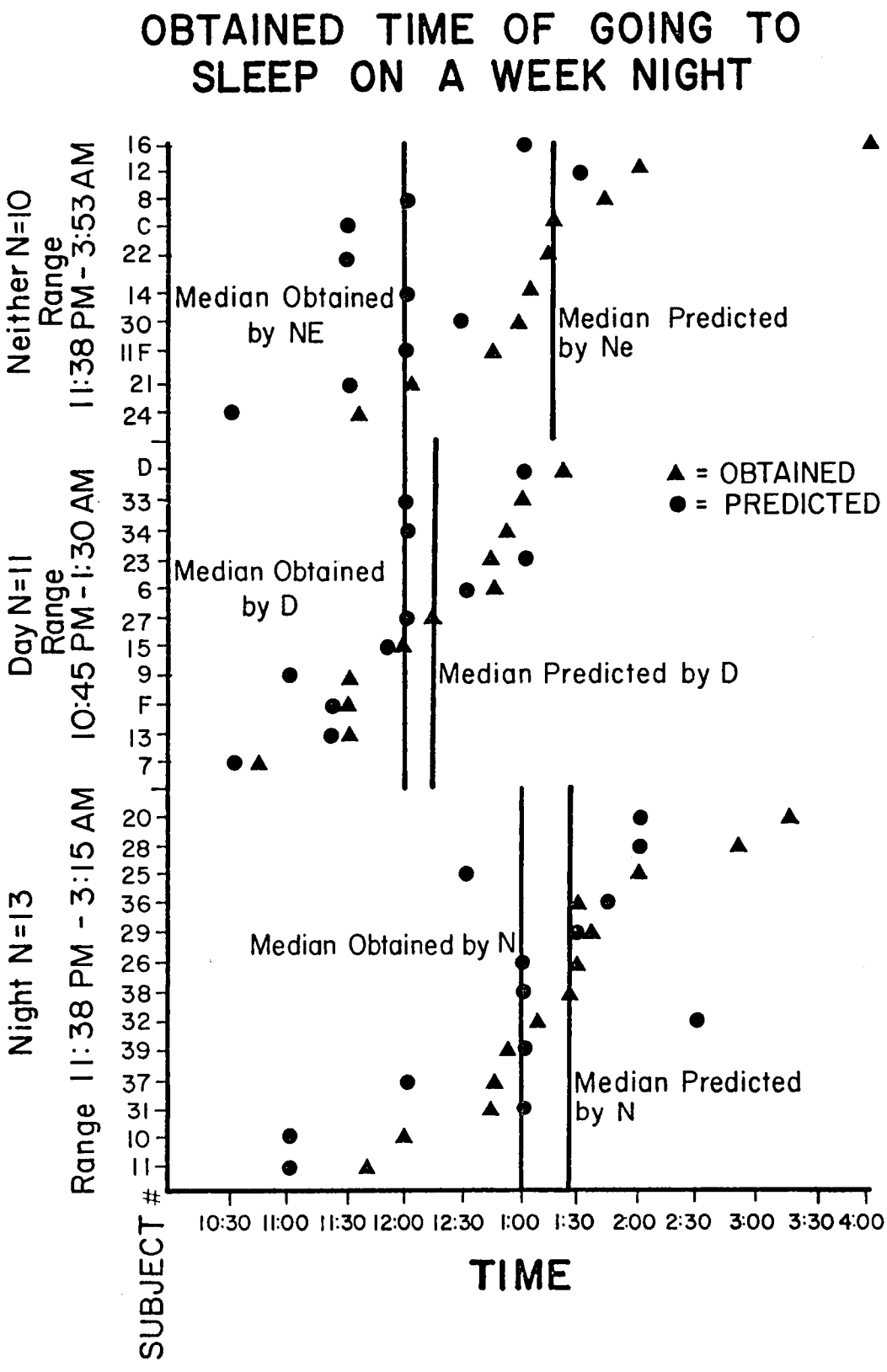


Figure 5. Obtained Time of Going to Sleep on a Weeknight.

Table 1. Profiles of Person Types from Questionnaire and Record Data.

	Obtained Weeknight Amount of Sleep	Obtained Weeknight Time of Going to Sleep	Mean Age	Sex		Obtained Mean Number of Naps	Predicted Mean Number of Stimulants per Day	Predicted Mean Number of Sedatives per Day	Predicted % of Subgroup Who Smoke Cigarettes
				Female	Male				
Night Person	7' 13"	1:23 a.m.	22	9	4	1.42	2.4	.96	46%
Neither Person	7' 15"	1:11 a.m.	22.5	5	5	.85	3.4	.4	20%
Day Person	7' 29"	12:15 a.m.	25	4	7	1.5	2.8	.4	9%

of sleep separated from the longest sleep period in the day by more than one hour. Another interesting aspect of napping involves times naps are taken. The Day and Neither groups tend to nap between Noon and 6 p.m. for about 50% of their naps and between 6 p.m. and Midnight for 45% of all their naps. Night persons, by contrast, took 46% of their naps during the Noon-6 p.m. interval and took only 34% of their naps from 6 p.m. to Midnight. Twenty percent of their naps fell between Midnight and Noon as compared with 3% of Day persons' naps. In absolute terms it is interesting to note that while the Neither group makes up 29.4% of the subjects in the sample only 20% of the 82 naps recorded were those of Neither persons. Night and Day groups each were responsible for roughly 40% of the naps taken.

Use of stimulants varied between all three groups. The Night group took an average of 2.4 stimulants in a typical day compared to a sample mean of 2.8. Day people's stimulant intake was equivalent to the 2.8 sample mean while Neither types averaged 3.4 stimulants used per day. Sedative use varied in the opposite direction across the three groups.

Night persons used the most sedatives, averaging .96 per day. This figure was more than twice as high as the mean sedative intake of the Day or Neither groups, both of which averaged .4 sedatives used per day. The sample mean was .62. It was also found that 64% of the high sedative users were cigarette smokers and that 78% of the cigarette smokers had a higher daily intake of sedatives than the sample mean. A correlation of .23 between these two variables was significant at the .0934 level.

Cigarette smoking seemed to be associated almost exclusively with subjects calling themselves Night persons. Only one of the nine smokers in the sample was a Day person (9% of the Days) and only two were Neither types (20% of the Neithers). Compared to a 26% occurrence of smoking in the sample, 46% of the Night people smoked at least one cigarette a day. Three of the six people this figure represents smoked less than 5 cigarettes a day. In addition the three light smokers in the Night group were the only light smokers in the sample. It is an interesting observation that all those persons in the sample who smoke at all but seem to be resistant to tobacco addiction (as evidenced in the fact that they smoke fewer than 5 cigarettes a day) describe themselves as Night persons. That these persons routinely use tobacco in another form is a possibility unfortunately not allowed for in this study (Table 1, page 38, includes this data).

Length of same sleep schedule and aspects of prediction accuracy were noteworthy. Fifty percent of the Neither group had had the same schedule for less than 7 months, compared to 54% of the Nights and 27% of the Days. We also note that fully 80% of the Neithers had had the same schedule for a year or less while 62% of the Night persons fit here and only 45% of the Day group fit. Further, 30% of the Neither group had had the same sleep schedule for less than one month. This compares to the 17% of the total sample that fits in this category.

It seems at this juncture that the Neither subgroup has some unique properties as well as some resemblance on some variables to the Night group and on other variables to the Day group. Regarding this condition

one can see that differences between Night and Day groups seem polar and indeed more striking if the Neither group is viewed as a mixed group; sometimes resembling the Nights on the whole and sometimes resembling the Days on the whole, depending on the peculiarities of one or two of its members. For this reason the Discussion of this investigation will treat the Neithers as mixed.

Accuracy of prediction was of course one of the major focuses of the study. Before examining the phenomenon per se, one should note its occurrence as a type characteristic. As regards prediction of Time of Going to Sleep, of the 34 subjects only four predicted a time of going to sleep that was later than the time of sleep each obtained during the recording period. Interestingly, of these four people, three were Night persons. Day persons were found on the whole to be accurate predictors of Time of Going to Sleep with 64% of the Day subjects predicting a time of going to sleep on weeknights within fifteen minutes of the median time he or she obtained. Only 31% of the Night people, by contrast were within this accuracy range, while none of the Neither subgroup were accurate on this variable. On the whole there was a much lower incidence of accurate Amount of Sleep prediction than of accurate Sleeptime prediction.

Of the Night persons in the study, 23% were accurate predictors of Amount of Sleep. A slightly higher figure of 27% of the Day persons were accurate here. One Neither type (10% of this subgroup) appeared among the accurate Amount predictors. Table 2 shows the reader the percentage of all subjects who were within 15 minutes, 30 minutes, etc.,

of their predicted times for the 10-day period. Twenty-three of the thirty-four subjects predicted they would get less sleep than they actually did on weeknights. Having seen how a person's schedule type corresponds to factors including prediction accuracy, we may now examine the data with regard to describing accurate predictors per se.

Table 2. Percentage of the 34 Subjects Whose Predicted Time Was within the Given Number of Minutes of the Time Obtained.

	Within ± 15"	Within ± 30"	Within ± 45"	Within ± 60"	Within ± 75"	Within ± 90"	Within ± 105"
Sleeptime	32	53	65	74	83	89	98
Amount of Sleep	24	53	74	86	89	95	98

Characteristics of Accurate Predictors of Sleep Habits

Accuracy of prediction was calculated for each of two sleep habits. Subjects were rank-ordered by accuracy at predicting time of going to sleep (Sleeptime) and by accuracy at predicting the amount of sleep one would obtain. A comparison of the two rank orders yielded a Kendall Rank Correlation Coefficient r of .219. This coefficient proved significant at the .034 level, which allows the conclusion that a single factor of accuracy at predicting the sleep habits probably does exist with the sample.

Because the range of accuracy was so large (see Difference in Minutes; Appendices D and E) and because the investigator desired to

compare these results with those of the pilot study, it was felt that the most informative way to examine the accuracy data was to treat the factors of Amount of Sleep and Sleeptime as separate rank orders. Subjects in either category were considered to fall in the Accurate subgroup if their predicted hour or amount was within 15 minutes of their obtained hour or amount. As the subject was only requested to record his habits to within 15 minutes, subjects whose accuracy was off by more than 15 minutes would produce values which could vary from their true value by more than 30 minutes. Given in addition the potential for error in the subject's memory, it was felt that subjects who missed their predictions by greater than the quarter hour could not be considered in the accuracy subgroup. Of the 34 subjects, eleven were accurate predictors of Sleeptime while seven were accurate predictors of Amount of Sleep. Only three of the 34 subjects were accurate predictors of both variables.

Accurate prediction of Sleeptime was a function of six factors (see Table 3):

1. The median age of the Accurate Predictors of Sleeptime was greater than the sample median.
2. The percentage of these persons who used more than an average number of stimulants was low in comparison to the sample.
3. Only one of the eleven (9%) smoked cigarettes compared to a 26% occurrence of smoking in the whole sample.
4. Accurate predictors of Sleeptime tended to have had the same sleep schedule for longer than one year.

Table 3. Values of Factors Making Up the Accurate Predictor of Sleeptime As Compared with Sample Values.

	Median Age	Percentage Who Use Greater Than the Mean Number of Stimulants	Percentage Who Smoked Cigarettes	Percentage Who Have Had Same Schedule for Longer Than One Year	Percentage Who Have a Modal "Most Active" Period of the Day of 10 a.m.-Noon	Percentage Who Have a Modal "Most Active" Period of the Day of 8 p.m.-10 p.m.
Accurate Predictors of Weeknight Sleeptime N=11	25	36%	9%	54%	27%	27%
Values for Whole Sample N=34	23.5	47%	26%	38%	21%	16%

The modal most-active periods for this group were (5) 10 a.m. to Noon and (6) 8 p.m. to 10 p.m. Any subject who fit 4 or more of these dimensions had only a 6% chance of not being recognized as an accurate predictor when he in fact was (false negative) and a 6% chance of being called an accurate predictor when he in fact was not (false positive). It should also be noted that 64% of the accurate Sleeptime predictors were Day people while 36% were Night people.

Accurate prediction of Amount of Sleep was a function of five factors (see Table 4):

1. Accurate predictors of Amount of Sleep napped less often than the sample as a whole (86% of this subgroup took fewer than the sample mean 1.28 naps per week compared to 74% of the sample who fell below this value).

2. Accurate predictors of Amount of Sleep were likely to have a low sedative intake.

3. Accurate predictors of Amount of Sleep were likely to be nonsmokers. Cigarette smoking then appears to be a factor in inaccurate prediction of both variables.

4. Accurate Amount of Sleep predictors for the most part report being less nervous than many or most people.

5. Modal most active periods between these subgroups overlapped on one count with 10 a.m.-Noon again being a factor in accurate prediction.

Any subject who fit 4 or more of these dimensions had a 9% chance of not being recognized as an accurate predictor of Amount of Sleep when he was (false negative) and an 18% chance of being called an accurate predictor when he was not (false positive).

Table 4. Values of Factors Making Up the Accurate Predictor of Amount of Sleep Profile As Compared with Sample Values.

	Percentage Who Took Fewer Than the Mean Number of Naps Taken Per Week	Percentage Who Took Fewer Than the Mean Number of Sedatives Per Day	Percentage Who Smoked Cigarettes	Percentage Who Reported Being "Less Nervous Than Many or Most People"	Percentage Who Have a Modal "Most Active" Period of the Day of 10 a.m.-Noon
Accurate Predictors of Weeknight Amount of Sleep N=7	86%	86%	14%	58%	21%
Values for Whole Sample N=34	74%	74%	26%	36%	16%

Accurate predictors of both variables can be seen from Table 5 to have five factors in common. This group of three (1) predicted taking fewer naps than the mean prediction of the sample, (2) did not use sedatives, (3) did not use cigarettes, (4) were less nervous than many or most people, and (5) had had the same sleep schedule for seven or more months. Only one other subject in the sample of 34 fit this profile. Interestingly, this subject was the least inaccurate of the inaccurate predictors of Amount of Sleep and was tied for that position among inaccurate predictors of Sleeptime.

Letting go, for a moment, of the concept of applying the accurate predictor profile in a future cross-sectional study the investigator sought to discover if a longitudinal study such as this one could be any further abbreviated in terms of time the subject spends keeping the sleep record. That is, exactly how many weekdays does the subject have to record before the mean Amount of Sleep or median Sleeptime for the days correlates .9 or better with that factor for the entire ten weekdays? Pearson Product-Moment Correlations were calculated comparing the mean (in the case of Amount of Sleep) or median (in the case of Sleeptime) of day 1 with that factor for days 1-10, of days 1 and 2 with days 1-10, of days 1, 2, and 3 with days 1-10, etc. By this analysis it was discovered that, taken as individual subgroups, it was only necessary to sample the first three days to attain a correlation between the 3 day median Sleeptime and the 10 day median Sleeptime of .9 or better for all three groups. It was further discovered that considering Night and Day persons as a unified group

Table 5. Characteristics of Subjects Who Accurately Predicted Both Sleeptime and Amount of Sleep.

Subject #	Age	Sex	Active*	Predicted Naps	Obtained Naps	Stimulants Used per Day	Sedatives Used per Day	Cigarettes Smoked per Day	N, D or Ne Type	Length of Same Schedule	Degree of Nervousness*
31	22	F	D, J	0	.5	4	0	0	N	E	B
13	50	M	F, E	1	1.5	3	0	0	D	D	B
15	25	F	F, J	0	.5	1	0	0	D	C	A

*See Appendix A.

did not decrease the number of days required for the .9 correlation to be attained.

It was found that one must sample a somewhat longer period to attain this .9 correlation for Amount of Sleep. Indeed one must sample Amount of Sleep for 6 days before all the individual subgroups have mean amounts of sleep correlating .9 or better with the 10-day means. In this condition it was found that treating Night and Day persons as a unified group allowed one to drop the sample time to 5 days without correlation for either the Night and Day person group or the Neither group dipping below the .9 figure.

CHAPTER V

DISCUSSION

This study yielded descriptions of subjects in the areas of sleeper type and characteristics of accurate sleep habit predictors. Night, Day and Mixed persons, described by this research, should be compared to types of sleepers considered in the pilot study and other research that describes people in terms of their sleep habits. While the literature on prediction accuracy vis-a-vis sleep habits is as yet nonexistent, we do have our pilot study results with which to compare our present findings.

Night and Day Persons

Our pilot study avoided any attempt to define Night, Day and Mixed persons on the basis of their responses to questionnaire items because it was felt that the stage of research sophistication and size of the sample were not great enough to expect any reliability or validity from such results. The variables of Time of Going to Sleep and Obtained Amount of Sleep for the groups, since they were verifiable by observation, were compared between studies.

As Table 6 shows, there are a number of consistencies between the two studies on these variables. Sleeptimes are latest among Night people in both studies. The finding that 12:45 a.m. was the dividing point for weeknight Sleeptimes between Day and Night groups in both studies is perhaps the most noteworthy finding of the entire study. Amount of

sleep obtained followed a consistent pattern across groups in both studies. In both studies Night persons as a group obtained the least sleep per weeknight with Days obtaining the most and the Mixed group falling between these two groups.

Table 6. Comparisons of Pilot Study and Current Study Findings on Obtained Sleeptime and Amount of Sleep for Person Types.

	Median Obtained Sleeptime		Obtained Amount of Sleep	
	Pilot	Current	Pilot	Current
Night	1:00 a.m.	1:23 a.m.	7' 22"	7' 13"
Mixed	12:18 a.m.	1:11 a.m.	7' 29"	7' 15"
Day	12:23 a.m.	12:15 a.m.	7' 43"	7' 29"

The profile of a Night person having a later Sleeptime on a weeknight than the Day person is similar to other profiles in the literature. The "Morning Sleeper" and "Evening Sleeper" of both Aschaffenburg (1908) and Winterstein (1932) resemble our Night and Day persons in this respect. Janz's (1974) Awakening Epileptic resembles our Night person in that he "falls asleep late in the evening" and his Sleep Epileptic by the same token resembles our Day person in falling "to sleep early in the evening." Horne and Ostberg's (1976) "evening" person also resembles our Night person in having a later time of day of feeling in need of sleep than did their "morning" person, who would resemble our Day person. The obtained bedtimes of their subjects followed the Morning-Intermediate-Evening pattern of earliest to latest seen in our results. Horne and

Ostberg found no significant differences in amount of sleep obtained by their three groups. According to the hypotheses of Ostberg (1973) as they relate to Hartmann's (1973) conclusions, the Morning person would be the "preprogrammed" type and would obtain less sleep than the evening "reprogramming" type. This prediction is in contradistinction to our finding that Day persons (corresponding on most indices to Ostberg's Morning type) actually obtain more sleep than do Night persons. Further study is needed to explain this suggested inconsistency in research findings to this point.

Having seen how Night and Day people compared on observable variables between the two studies and how these findings relate to the literature, it seems important to note what parallels exist between our findings on Types of persons and the findings in the literature on types. For purposes of this explication the Mixed type group included in our study will be minimally considered. In studies by Horne and Ostberg (1976) and Ostberg (1973) which include an "intermediate" or "middle" type, this type usually resembles, contrary to our findings, the morning type on most indices. However, Horne and Ostberg (1976) note that, "The intermediate group is probably made up of afternoon types and also a 'both Morning and Evening type.'" Further, in our study as well as theirs "the questionnaire was specifically designed to identify Morning [Day] and Evening [Night] types, and therefore at present the Intermediate group can only be defined as not being clearly within the parameters of either the Morning or Evening types" (p. 108).

A number of tendencies noted on our data on types of sleep schedules find support in the literature. We noted that periods of greatest activity were latest in the Night group and earliest in the Day group. Janz's (1962, 1974) finding that the Awakening Epileptic is most active in the afternoon fits here. Horne and Ostberg's (1976) conclusion that the Morning person's performance quality and mental peak fell early in the day also supports our findings.

Hartmann's (1972) finding that long sleepers go to bed earlier than short sleepers is consistent with our data insofar as going to bed early implies sleeping longer and our Day group got the greatest amount of sleep of the three groups. Our conclusion that the Day group went to sleep earliest also fits Hartmann's suggestion here that long sleepers go to bed earlier. Horne and Ostberg's (1976) aforementioned result that Morning persons feel sleepy earlier in the day than Evening types is consistent here.

Our earlier suggestion that Janz's (1962, 1974) Awakening Epileptic resembles our Night person is further supported by our finding that the Night person group has the latest average Sleeptime of any group. Tune's (1969) statement that the "early to bed, early to rise" habit increases with advancing age supports in the obverse our conclusion that Night persons are the youngest and latest to sleep of any group.

The reader will remember our earlier proposition that our Day persons corresponded to the Morning type delineated by Horne and Ostberg (1976) especially insofar as the evidence supports that they may have an autonomous sleep cycle. In this same context Horne and Ostberg noted

that the Morning person has a natural Sleeptime that is the same as the one that would be imposed on him by routines in the environment. It follows that the Morning person, because he always has the same schedule, would be more likely to be able to accurately predict this schedule than would the Evening person whose schedule changes according to the zeitgeber. In light of this then, it is no surprise that while only 32.4% of the sample were Day people, 64% of the accurate predictors of Sleeptime were Day people.

A final important finding of our research on types of persons as regards their sleep habits was in the area of gender. Our study found that Night persons were female by a ratio of 9:4. Since it was also true that the Night persons averaged less sleep per night than any other group it may be safe to say that our study offers support for the statements by Tune (1968), Strauch and Wollschlager (1973), and Pleimes (1973) to the effect that women get less sleep per night than do men. Whether our 9:4 ratio represents coincidence or a genuine interaction between gender and sleep habits remains to be established.

Accurate Predictors of Sleeptime and Amount of Sleep

As we have stated, published findings on the nature of accurate predictors of sleep habits do not exist at present. Thus, the researcher in this fledgling field is guided toward making a guarded analysis of the data. Beyond the simple delineation of findings completed in the preceding section of this report, the analysis can

only consist of a comparison of those findings with the results of our earlier, pilot, study and the noting of apparent internal contradictions in this study's results.

Von Bertalanffy's principle of equifinality is based on the proposition that unicausality of a phenomenon is a fiction, i.e., that every result has a multiplicity of contributing "causes." Operating on this assumption, we derived from our pilot study the factors most associated with accuracy of prediction of Sleeptime and Amount of Sleep. Accurate Sleeptime prediction in the pilot was found to be related to (1) being female, (2) being most-active from 2-4 p.m., (3) napping at least once a week, (4) consuming more than the median number of stimulants per typical day, (5) consuming more than the median number of sedatives per typical day and (6) describing oneself as a Night person. Subjects fitting two or more of these characteristics had a 100% chance of being an accurate Sleeptime predictor and no nonaccurate Sleeptime predictor fit two or more of the criteria. In comparison, only one of the indices on which accurate Sleeptime predictors were discriminated in the larger study, that of stimulant use, was an index variable in the pilot. Even at this, it was found that decreased stimulant use was associated with accurate Sleeptime prediction which is the opposite of the pilot finding on the significance of this variable.

Within this study's findings there is one curious inconsistency. The reader will notice that there are two modally "most active" periods which mark the accurate Sleeptime predictor; 10 a.m.-Noon and

8 p.m.-10 p.m. We note that the earlier of these periods is a "most active" period of the Day group while the later is a "most active" period of the Night group. This apparent paradox gives pause to the reader who, noting the high percentage of Day persons who are accurate Sleeptime predictors and vice versa, might wish to equate accurate Sleeptime prediction with being a Day person. While it is likely that a Day person is an accurate Sleeptime predictor and an accurate Sleeptime predictor is likely to be a Day person, an equivalence should not be drawn due to the presence of a factor in the accurate Sleeptime predictor profile which is so exclusively related to Night persons.

Accurate prediction of Amount of Sleep was determined in the pilot to be a function of (1) age greater than the sample median, (2) consuming greater than the median number of sedatives per typical day and (3) being a Night or Neither type person. Subjects fitting two or more of those criteria had a 100% chance of being classified Accurate Predictors of Amount of Sleep and no person who fit two or more of the factors was not an accurate Amount predictor. Our larger study again yielded an accurate Amount predictor profile which shared only one variable with the pilot profile. This variable was that of sedative intake and the finding that Accurate Amount predictors took fewer sedatives than the sample median was again the opposite finding of that in the pilot study.

The lack of congruence between pilot profiles of the two kinds of predictors and this study's profiles of the two kinds makes clear that more research needs to be undertaken before Accurate Predictor Profiles of these variables individually can be proscribed with any degree of

certainty. Some attempt at explaining this lack of agreement will follow. However, the original purpose in beginning this research was to determine if an Accurate Predictor Profile across the two dimensions could be ascertained.

Given this, it should be pointed out that the Accurate Predictor Profiles of the two groups have two facts in common; a "most active" period of 10 a.m.-Noon and a lowered incidence of cigarette smoking. Only one variable, lowered cigarette smoking, is a characteristic of the profile of Accurate Predictors of Both Variables. Neither of these methods then, of describing a unitary Accurate Predictor of Sleep Habits yields comfortably small false positive and false negative values. Thus the hypothesized unitary profile awaits further research for its exposure.

Methods Differences and Differential Effects on Results in This and the Pilot Study

A number of variables may be seen to partially account for the discrepancies between this study and the earlier one. The size and method of selecting the two samples varied, with the pilot being a small nonrandom sample while this study was much larger and probably came closer to accurately representing the population from which it was drawn. The median age of this sample was considerably younger than that of the pilot. Knowing Hartmann's (1972) conclusion that sleep patterns probably do not stabilize until as late as age 20 one might hypothesize that some differences between samples reflect the immaturity of a higher percentage of subjects in the larger study.

A number of the pilot sample members were relatives of the investigator. Though they were blind to the purpose of the study, this confounds the pilot results both in terms of the degree and kind of commitment to the study and in terms of possible genetic or early environmental determinants of habits. The fact that the investigator personally knew all his pilot subjects may have been a confounding factor both in terms of their commitment to the study and insofar as the initial style of presentation of the problem was different from that of the larger study and may have affected subject interest and involvement.

Subjects and procedures differences may have also been enhanced by differences in measures between the two studies. While the questionnaire used in this study was quite similar to the pilot's questionnaire, there were differences in wording of questions and the larger study added some questions and deleted others. The record form used in this study was quite different from that of the pilot and as such probably affected the subject's ease and accuracy of recording. It becomes apparent that the difference in methods between the two studies are so great as to make comparisons of their results very risky at best. There are however, several results of the larger study which have not yet been touched upon and should be considered in their own right.

Observations

In the results section it was noted that Day and Mixed persons napped almost exclusively between Noon and Midnight while Night persons napped with significant frequency during the Midnight to Noon interval. McGhie

and Russell (1962) noted that "as age advances the sleep pattern changes in the direction of shorter, lighter and more broken sleep." This suggests that a tendency toward polycyclicity of sleep with increasing age may be operating. Were this the case it would be tempting to hypothesize that the obtained variance in nap times for the Night group was due to this polycyclic tendency. Unfortunately the fact that the Night group has the youngest median age (22) of any subgroup argues strongly against this interpretation as does Lewis and Masterton's (1957) finding that there was no relationship between "frequency of intervals of interrupted sleep" and frequency of naps. Probably the most fitting explanation at this juncture for the suggestion of a polycyclic sleep cycle in Night persons lies in Hartmann and others' (1972) suggestion that sleep habits do not stabilize until about age 20 as well as the consideration that at age 22 most of the subjects are undergraduate students while, with a median age of 25, most Day persons are probably not undergraduates. This hypothesis fails to explain why the Mixed group, with a median age of 22.5, so resembled the Day group and had proportionately fewer naps altogether than either other group.

Another peculiarity of the Mixed subgroup was the absence of its members in the Accurate subgroups. It appears that the Mixed group may be inaccurate because as a group their habits are of a shorter duration than is true of the other groups. It would be expected that over time a Mixed type might become a Day or Night type and his prediction accuracy might improve. However it may also be true that a true Neither type exists and that one characteristic of this type is that

his sleep schedule varies such that he never has the same schedule for any length of time or never for as much as a year and cannot accurately predict it because in his case past behavior is simply a poor predictor of future behavior. This discussion also leaves undecided Horne and Ostberg's (1976) speculation as to whether the Intermediate sleeper type is an "afternoon type" or a "both Morning and Evening type."

From the present data it was obvious that a correlation exists between sedative use and cigarette smoking. Persons who regard cigarettes as sedatives or who have observed the concurrence of smoking and drinking among alcohol drinkers will not be surprised by this finding. However, the exact nature of the relationship between sedative use and cigarette smoking remains to be seen.

Methods Modifications in Future Research

After this study was already begun, Horne and Ostberg's (1976) research on Morningness-Eveningness in terms of body temperature curves and behavioral variables came to this researcher's attention. While these researchers noted the need for further validation of their Morningness-Eveningness questionnaire, it is still far and away the most comprehensive treatment of this phenomenon in English to date. While Horne and Ostberg's subjects did keep logs of bed and arising times the chief validation method they used was to compare the mean oral temperature curve of the group of self-described Morning persons with those of the Evenings and Intermediates. The present study however, is aimed at ultimately producing a valid one-shot behavioral sampling

method for studying this phenomenon and consequently it stressed validation through detailed observation and recording. Some lessons for future research can be learned from Horne and Ostberg, especially in relation to the evolution of a Morningness-Eveningness questionnaire (see Appendix F for Horne and Ostberg's Questionnaire).

To adapt Horne and Ostberg's questionnaire to this line of research a number of elements from the present questionnaire would be added. The new questionnaire would require a statement by the subject as to his typical weeknight Sleeptime and Amount of Sleep. We would also want an estimate of the number of naps, stimulants and sedatives the subject typically takes. As the role of cigarettes in sleep habits seems potentially significant we would want to include an estimate of amount and frequency of tobacco use in the subject. Finally we would want to add scales allowing the specification of length of time the subject has had the same schedule and his estimate of his degree of "nervousness" in relation to the population as a whole.

The record form we adapted from Lewis (1961) and Tune (1969) was used accurately without complaint by all subjects in our study. We noted that about half the subjects preferred a blank they could hang up rather than place on a table. These results allow the conclusion that no modification in the record form is needed at this point for research in this area to proceed.

While no subject objected to recording his habits for a full two weeks, it would simplify future research and perhaps encourage subject participation in that research if the number of days which the record

must be kept was reduced. The analysis of central tendency mentioned in the results has shown that in future research the number of weekdays one must sample in order to obtain accurate representation of the phenomena studied can indeed be cut from the ten days sampled in the present study. Future studies describing accurate sleep habit predictors or attempting to accurately determine sleep habits need only require the subject to record his habits for six weekdays.

Subsequent Research Questions

The results of our study suggest further research is needed into both the areas of types of persons with respect to sleep habits and of validating Accurate Predictor Profiles. The questions of obtained weeknight Sleeptime and Amount of Sleep need replication as does the obtained Night-Mixed-Day continuum of lateness of Sleeptime regardless of the values obtained per se. The evidence for 12:45 a.m. being the dividing point in time between Day and Night person Sleeptimes would be stronger if this figure was replicated.

We will want to see how closely another sample will fit the 1:23 a.m., 1:11 a.m. and 12:15 a.m. obtained weeknight Sleeptimes of the Night, Mixed, and Day persons respectively. While differences between groups on obtained Amount of Sleep are small (indeed Horne and Ostberg-1969-found no significant differences) it will be interesting to see if the 7'13", 7'15" and 7'29" obtained weeknight Amounts of Sleep of Night, Mixed and Day persons respectively are borne out.

We will also want to see if, in another study, accurate Sleeptime predictors are (1) older, (2) lower stimulant users, (3) lower

cigarette users, (4) have longstanding schedules and are most active from (5) 10 a.m.-Noon and (6) 8 p.m.-10 p.m. compared to the whole sample. Further, we will want to know if accurate Amount of Sleep predictors are (1) rare nappers, (2) lower sedative users, (3) nonsmokers, (4) less nervous and (5) active from 10 a.m.-Noon in comparison to the sample.

Now that a large enough sample of sleepers has been gathered that one can begin to see discriminating factors in the makeup of accurate sleep habit predictors, it would allow for stronger conclusions if the next study on this subject employed a more complex analysis than the simple descriptive one used here. The investigator would want to know what combination of factors in a subject would best discriminate an accurate predictor from the rest of the sample. Given this need, it seems that later researchers will want to design their studies so that the data will lend itself to the use of a discriminate analysis technique.

This study represents another early step in the explication of Night and Day persons. The present work adds some data to the newly risen field of the description of Night and Day persons. Validation of observational sampling methods in this field has been furthered significantly by our research but awaits further exploration before a shift from longitudinal to cross-sectional sampling will be appropriate.

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APPENDICES

APPENDIX A

Subject Number: ___

Age: ___

Sex: ___

QUESTIONNAIRE ON SLEEP HABITS

1. List here your most typical time of going to sleep for a work/school day. Be sure to include a.m. or p.m. If you typically have more than one sleep period per day list the time for all periods. Periods of sleep interrupted by even prolonged periods of wakefulness devoted to returning to sleep should not be counted as more than one sleep period.

   Time of going to sleep: ___

2. List here the amount of sleep, in hours, that you typically get in a night before a work/school day.

   Amount of sleep: ___ hours

3. Put a check mark beside the two time periods in which you are most active during a typical day.

A.	Mid.-2 a.m. ___	G.	Noon-2 p.m. ___
B.	2 a.m.-4 a.m. ___	H.	2 p.m.-4 p.m. ___
C.	4 a.m.-6 a.m. ___	I.	4 p.m.-6 p.m. ___
D.	6 a.m.-8 a.m. ___	J.	6 p.m.-8 p.m. ___
E.	8 a.m.-10 a.m. ___	K.	8 p.m.-10 p.m. ___
F.	10 a.m.-Noon ___	L.	10 p.m.-Mid. ___

4. How many days during the week do you sleep more than once a day?

   Number of days: ___

5. Give the average number of cups of caffeinated coffee, tea, cola, over-the-counter stimulants (No-Doz, Vivarin, etc.), prescription stimulants and prescription diet pills you take in a typical day. Count each type of these as being equivalent in strength to all others in this question.

   Average number per day: ___

6. Estimate the number of hours before bedtime that you typically finish consuming the last stimulant you take in a typical day.

   Number of hours before bedtime: ___

7. Give the average number of 12 oz. cans of beer, 2 oz. shots of liquor, marijuana cigarettes, over-the-counter sleeping pills (Sominex, Nytol, etc.) and prescription sedatives, tranquilizers and sleeping pills you take in a typical day. Count each type of these as being equivalent in strength to all others in this question.

   Average number per day: ___

8. Estimate the number of cigarettes you smoke in a typical day.

   Average number per day: ___

9. Would you describe yourself as a Day person, a Night person or as Neither one?

   Day person ___ Night person ___ Neither ___

10. I have had essentially the same sleep schedule for

   A. Less than one month. ___
   B. One to six months. ___
   C. Seven months to one year. ___
   D. One year to two years. ___
   E. Longer than two years. ___

11. As far as nervousness goes, I am (Check one only)

   A. Less nervous than most people. ___
   B. Less nervous than many people. ___
   C. About as nervous as most people. ___
   D. More nervous than many people. ___
   E. More nervous than most people. ___

APPENDIX B

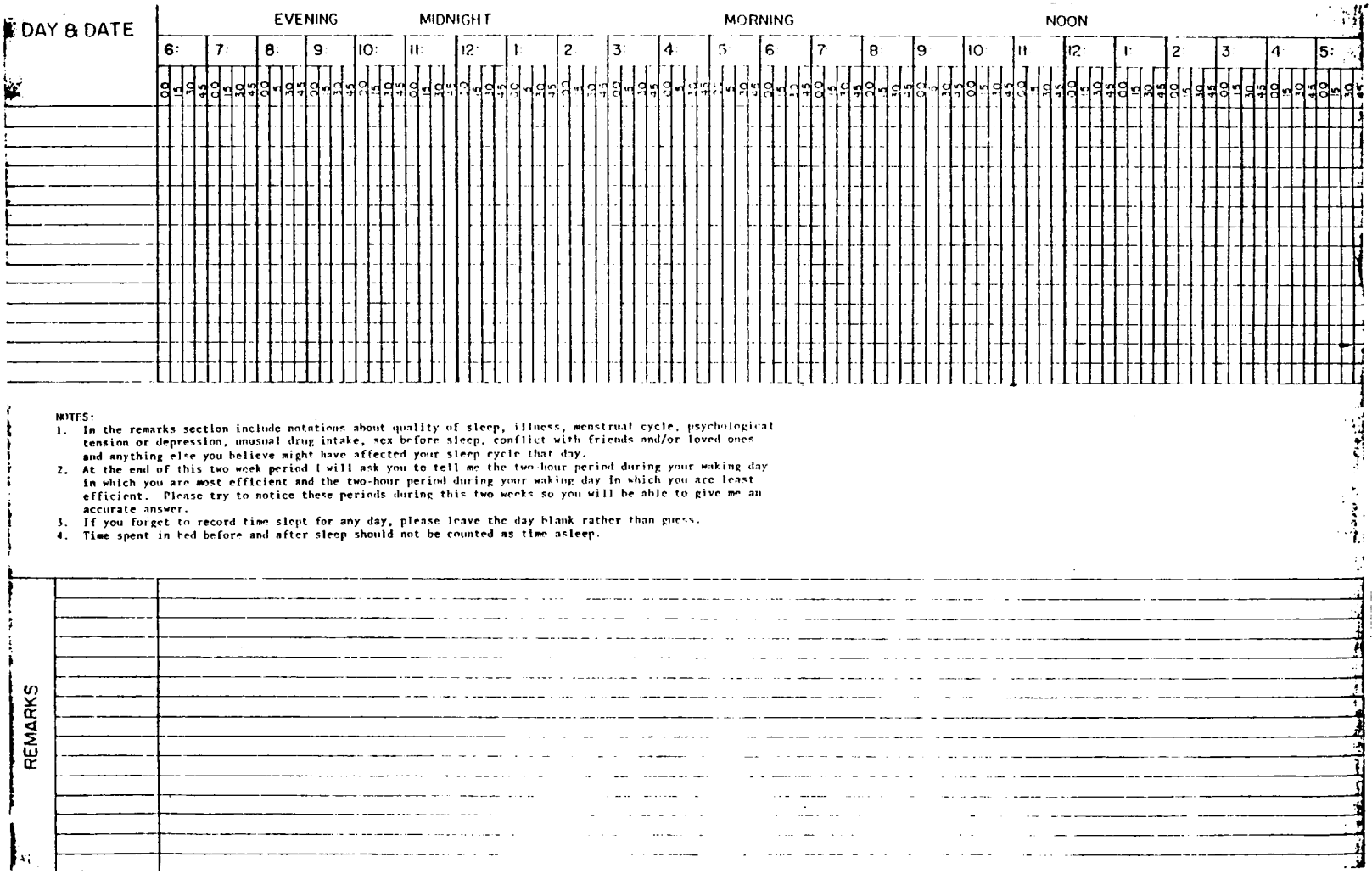


Figure 6. Record Form Used in Study.

APPENDIX C

STUDY DESCRIPTION AND CONSENT FORM

I would like you to indicate whether or not you are willing to participate in a study for my doctoral dissertation. The purpose of this study is to gain information about people's sleep habits and a person's ability to say what those habits are. The study will have three parts. First you will be asked to decide whether or not you will participate in the study. If you decide to do so, you will be asked to sign this form and will be assigned a subject number. In order to insure that you will remain unidentified with your questionnaire you will be assigned a subject number which will appear on your questionnaire and record but will never appear in conjunction with your name. After signing this form you will fill out the questionnaire. Following this you will consult with a graduate assistant about a sleep habits recording form. This record, which you will keep for two weeks, will be thoroughly explained to you by the graduate assistant.

Phase Two of the study involves your keeping the record every day for two weeks. Your graduate assistant will call you sometime during the next three days and again at the end of the first week to answer questions or help you solve any problems that have come up. As a subject you should feel free to call me at any time during the study with any problem or question you have.

Phase Three is another group meeting at the end of the two-week period. At this meeting you will turn in your record and I will give a more thorough explanation of the purposes and research questions of the

study as well as what is already known about the area studied. My main concern at this meeting will be to receive your record. You may stay on for the discussion if you wish but you will not be required to do so.

Thus if you decide to participate I will ask you to fill out the questionnaire here today and meet with the graduate assistant assigned to you. The remainder of the meeting today will take less than a half-hour. Subjects in my original study found that recording takes less than a minute a day and the final meeting need take less than five minutes. The study should therefore require less than an hour of your time. This form is a consent form which the Psychology Department and the University require me to obtain from each subject before the subject begins the experiment. Before you sign the form you should be aware of several things about the study. The first of these is that you understand the purpose of the study as I have described it to you verbally a few minutes ago. If you have any questions remaining about the study's purposes please ask me those at this time. Secondly in signing this form you will be acknowledging that I have informed you of the possibility that attending to your sleep habits may make you somewhat anxious about them. As you are not being paid for your work with me you also acknowledge that the benefits you receive from the study consist of increased insight into the sleep habits of yourself and others and, if you are an undergraduate psychology student, with permission of your instructor you may receive extra credit toward your grade in the amount specified by your instructor. Two final notes: As I have said you are free to ask me or your graduate assistant

questions about the purposes or procedures of this study at any time and you are free to withdraw from the study at any time and still receive, if you are a psychology student, full credit for your participation.

I have read the study description and consent form above, the questionnaire and the record form to be used in the study and I agree to participate.

Signed _____ Date _____

APPENDIX D

Table 7. Rank Ordered Prediction of Amount of Sleep.

S#	Diff. in Min.	Age	Sex	Active	Nap P.	Nap O.	Stim.	Hrs. . before bed	Sed.	Cig.	N,D,Ne	Same	Nervous-ness
11	0	29	M	G, I	0	.5	0	0	0	0	N	A	A
31	6	22	F	D, J	0	.5	4	6	0	0	N	E	B
25	11	19	M	E, G	4	0	1	3	0	0	N	B	C
13	11	50	M	E, F	1	1.5	3	2	0	0	D	D	B
12	12	18	M	G. L	0	0	6	1	2	15	Ne	A	C
D	15	22	F	F, I	0	0	1.5	4	0	0	D	D	D
5	15	25	F	F, J	0	.5	1	8.5	0	0	D	C	A
30	18	24	F	G, K	1	.5	2	1	0	0	Ne	D	B
9	23	28	M	D, E	0	0	8	2	0	0	D	E	C
10	23	30	F	F, K	0	1	3	3	2	25	N	D	C
20	23	26	F	A, L	3	1	3	7	0	40	N	E	C
7	27	29	M	E, F	0	.5	5	5	0	0	D	D	C
33	28	19	M	E, L	0	0	1	6	1	0	D	A	B
23	29	26	M	F, K	4	5	0	-	0	0	D	B	B
39	29	22	F	J, K	2	3.5	0	0	0	0	N	D	A
27	30	24	M	G, K	1	.5	2	4	1	0	D	C	C
6	33	26	F	F, K	1	1	4	12	.5	0	D	E	C
11F	34	27	F	I, J	2	2	1	8	0	0	Ne	C	B
C	38	22	F	E, H	2	0	0	0	0	0	Ne	A	B
34	38	25	M	F, G	5	6	4	5	2	18	D	B	C
21	39	19	F	F, J	0	0	1	5	0	0	Ne	B	C
29	41	29	M	K, L	4	.5	1	12	2	0	N	B	D
16	42	23	M	A, F	2	2	2	12	1	50	Ne	A	C
28	45	29	F	F, H	0	1	6	1	0	0	N	B	C
14	49	31	M	F, H	2	1	3	5	1	0	Ne	C	A
24	54	18	M	G, K	3	2.5	7	1	0	0	Ne	C	D
F	55	19	F	E, F	3	1.5	1	5	0	0	D	E	D
38	56	18	F	K, L	2	1	5	2	.5	15	N	B	C
8	69	34	M	E, F	1	0	8	.5	0	0	Ne	E	C
37	81	19	F	J, K	4	1	2	5	1	2	N	B	C
22	90	21	F	G, I	0	.5	4	2	0	0	Ne	B	E
32	92	20	F	A, J	3	2.5	1	10	1	1	N	C	C
36	110	19	F	G, K	4	4.5	1	11	6	4	N	B	C
26	114	19	M	E, L	4	1.5	4	2	0	0	N	E	B

APPENDIX E

Table 8. Rank Ordered Prediction of Time of Going to Sleep.

S#	Diff. in Min.	Age	Sex	Active	Nap P.	Nap O.	Stim.	Hrs. before bed	Sed.	Cig.	N,D,Ne	Same	Nervousness
36	0	19	F	G, K	4	4.5	1	11	6	4	N	B	C
39	3	22	F	J, K	2	3.5	0	0	0	0	N	D	A
29	8	29	M	K, L	4	.5	1	12	2	0	N	B	D
13	10	50	M	E, F	1	1.5	3	2	0	0	D	D	B
F	10	19	F	E, F	3	1.5	1	5	0	0	D	E	D
15	13	25	F	F, J	0	.5	1	8.5	0	0	D	C	A
6	15	26	F	F, K	1	1	4	12	.5	0	D	E	C
7	15	29	M	E, F	0	.5	5	5	0	0	D	D	C
23	15	26	M	F, K	4	5	0	--	0	0	D	B	B
27	15	24	M	G, K	1	.5	2	4	1	0	D	C	C
31	15	22	F	D, J	0	.5	4	6	0	0	N	E	B
30	23	24	F	G, K	1	.5	2	1	0	0	Ne	D	B
38	23	18	F	K, L	2	1	5	2	.5	15	N	B	C
D	23	22	F	F, I	0	0	1.5	4	0	0	D	D	D
9	30	28	M	D, E	0	0	8	2	0	0	D	E	C
12	30	18	M	G, L	0	0	6	1	2	15	Ne	A	C
26	30	19	M	E, L	4	1.5	4	2	0	0	N	E	B
11	38	29	M	G, I	0	.5	0	0	0	0	N	A	A
21	38	19	F	F, J	0	0	1	5	0	0	Ne	B	C
11F	45	27	F	I, J	2	2	1	8	0	0	Ne	C	B
37	45	19	F	J, K	4	1	2	5	1	2	N	B	C
28	53	29	F	F, H	0	1	6	1	0	0	N	B	C
34	53	25	M	F, G	5	6	4	5	2	18	D	B	C
10	60	30	F	F, K	0	1	3	3	2	25	N	D	C
14	67	31	M	F, H	2	1	3	5	1	0	Ne	C	A
24	68	18	M	G, K	3	2.5	7	1	0	0	Ne	C	D
20	75	26	F	A, L	3	1	3	7	0	40	N	E	C
32	82	20	F	A, J	3	2.5	1	10	1	1	N	C	C
25	83	19	M	E, G	4	0	1	3	0	0	N	B	C
33	90	19	M	E, L	0	0	1	6	1	0	D	A	B
8	105	34	M	E, F	1	0	8	.5	0	0	Ne	E	C
22	105	21	F	G, I	0	.5	4	2	0	0	Ne	B	E
C	105	22	F	E, H	2	0	0	0	0	0	Ne	A	B
16	173	23	M	A, F	2	2	2	12	1	50	Ne	A	C

APPENDIX F

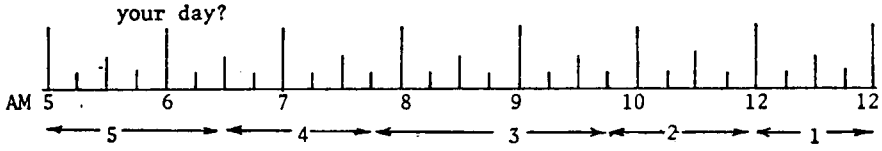
The final questionnaire

Instructions:

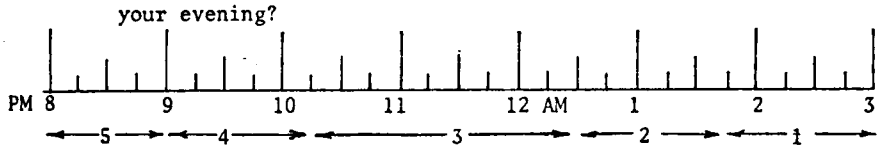
1. Please read each question very carefully before answering.
2. Answer ALL questions.
3. Answer questions in numerical order.
4. Each question should be answered independently of others. Do **NOT** go back and check your answers.
5. All questions have a selection of answers. For each question place 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.
6. Please answer each question as honestly as possible. Both your answers and the results will be kept, in strict confidence.
7. Please feel free to make any comments in the section provided below each question.

The Questionnaire, with scores for each choice

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



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?



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 mornings?	Not at all easy	☐	1
	Not very easy	☐	2
	Fairly easy	☐	3
	Very easy	☐	4
5. How alert do you feel during the first half hour after having woken in the mornings?	Not at all alert	☐	1
	Slightly alert	☐	2
	Fairly alert	☐	3
	Very alert	☐	4

A MORNINGNESS-EVENINGNESS QUESTIONNAIRE 101

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

Very poor	1
Fairly poor	2
Fairly good	3
Very good	4

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

Very tired	1
Fairly tired	2
Fairly refreshed	3
Very refreshed	4

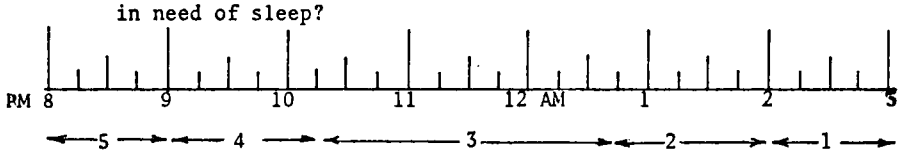
8. When you have no commitments the next day, at which time do you go to bed compared to your usual bedtime?

Seldom or never later	4
Less than one hour later	3
1-2 hours later	2
More than two hours later	1

9. You have decided to engaged in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is between 7.0-8.0 a.m. Bearing in mind nothing else but your own "feeling best" rhythm, how do you think you would perform?

Would be on food 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?



11. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two 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 a.m.	6
11:00 a.m.-1:00 p.m.	4
3:00-5:00 p.m.	2
7:00-9:00 p.m.	0

12. If you went to bed at 11:00 p.m. 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 be 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 but will fall asleep again ☐ 2
- Will NOT wake up until later than usual ☐ 1

14. One night you have to remain awake between 4:00-6:00 a.m. 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

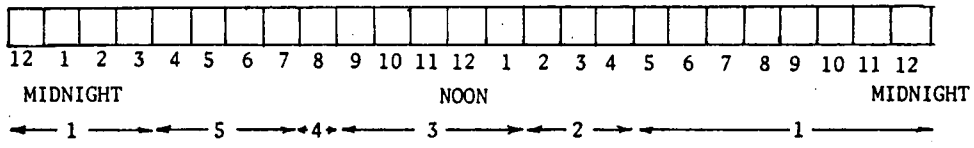
15. You have to do two hours of hard physical work. You are entirely free to plan your day and considering only your own "feeling best" rhythm which ONE of the following times would you choose?

- 8:00-10:00 a.m. ☐ 4
- 11:00-1:00 a.m. ☐ 3
- 3:00-5:00 p.m. ☐ 2
- 7:00-9:00 p.m. ☐ 1

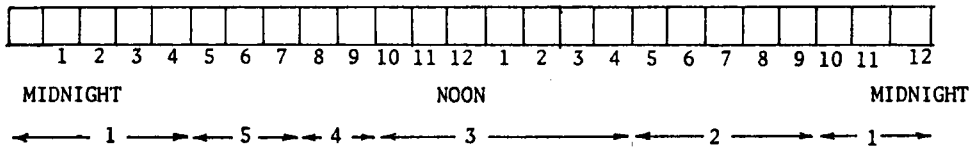
16. You have decided to engaged in hard physical exercise. A friend suggests that you do this for one hour twice a week and the best time for him is between 10:00-11:00 p.m. Bearing in mind nothing else but your own "feeling best" rhythm how well do you think you would perform?

- 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?



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



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

EXTERNAL VALIDATION OF THE QUESTIONNAIRE The criterion of individual differences in the circadian variation of oral temperature was taken as an external validation of the questionnaire. Forty-eight subjects were randomly selected from the original pool of 150 subjects and were paid to regularly measure their oral temperature, using calibrated mercury-in-glass thermometers. It was found from the completed questionnaires that the sample consisted of 18 moderate to definite Morning types, 20 moderate to definite Evening types and 10 Intermediate types. For each day throughout a three week period each of these subjects took their oral temperature at approximately half hour intervals commencing upon awakening and ending at bed-time. Measurements were not taken during sleep. A high daily sample rate over many days was necessary to average out: (a) error of fine measurement inherent with mercury-in-glass thermometers, (b) daily individual fluctuations within the circadian trend of oral temperature. Subjects retained their own thermometer. They were carefully trained in reading thermometer scales and were instructed to place the thermometer well under the tongue with mouth shut for five minutes. Measurements were not taken (1) during eating, drinking, smoking and changing environment, and within 20 minutes of completing these activities, (2) during exercise, and within 2 hours of completing exercise.

VITA

Harwell Fitzhugh Smith III was born in Heidelberg, Germany, of American parents on November 1, 1951. He attended elementary and secondary school in Albuquerque, New Mexico, and Oak Ridge, Tennessee, and was graduated from Oak Ridge High School in 1969. The following September he entered Memphis State University. After one year he transferred to the University of Tennessee where in March 1973 he received a Bachelor of Science degree with honors in Psychology. In the fall of 1973 he entered the clinical psychology program at the University of Tennessee. He received his Master of Arts degree in August 1976. He is currently completing his internship at the Memphis Clinical Psychology Internship Consortium. He was married in June 1977 to Marthanne Olivia Manion.