AN INVESTIGATION OF THE RELATIONSHIP BETWEEN TIME PREFERENCE AND DEVELOPMENTAL STAGE IN THE LIVES OF ADULT FEMALES

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Abstract

An Investigation Of The Relationship Between Time Preference And Developmental Stage In The Lives of Adult Females

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Research has been conducted documenting the occurrence of biological rhythms in all aspects of life. Researchers have shown that an individual's time preference for morningness or eveningness parallels some biological rhythms. Others have shown that biological rhythms are stable across the life span. Preliminary studies have been conducted on adult developmental stages. These studies have shown that adults, like children, travel through distinct stages. This study arose when many women reported being an evening type when they were young adults, but changed to being a morning type when they had children. This study was designed to investigate whether a woman's time preference is dependent upon adult developmental stage and therefore a means to adapt to their changing responsibilities.

This study recruited 200 women, between the ages of 40 to 60 years. All subjects bore primary child rearing responsibilities for at least one child. Subjects completed A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms for three periods in their lives; when they had finished school but did not have

children, when they had pre-school children, and the present. For each time period, subjects completed the questionnaire to document their time preference.

It was hypothesized that an individual's time preference is not an inherent biological rhythm, but rather is an aspect of their developmental stage. It was specifically hypothesized that subjects would be most morning while raising pre-school children. This hypothesis was not fully supported. Questionnaire scores for the morning type sub-sample were linear at all time points. This indicates that for this sub-sample, adult developmental stage did not influence time preference. For all other subjects there was a significant increase in scores (more morningness) from the prechildren to children questionnaire. This data partially supports the original hypothesis, indicating that adult development does influence time preference. The second hypothesis stated that evening types would show greater variance in questionnaire scores than the morning types. This hypothesis was supported.

Nurses and other health professionals can use this information to further explore the relationship between time preference and the effectiveness of time adjusted therapeutic regimens.

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BACKGROUND

Introduction

The purpose of this study was to explore individual time preference and its relatedness to two major theories, biological rhythms and adult development. Biological rhythms are an inherent aspect of every living creature's internal and external environment. Rhythms are found in the light-dark cycle, tides, lunar phases, and seasonal changes of the surrounding environment. In humans, internal biological rhythms originate early in life, possibly even in fetal life, and continue through the entire life span. Biological rhythms control, for example, the ebb and flow of body temperature, hormone levels, menstrual flow, and mental alertness. Changes in a persons's daily activity cycle also exist. Some people wake up early in the morning and get right to work, while others rise much later and become most active in the evening. Differences in circadian rhythms of body temperature and food intake patterns have been demonstrated in these two different types of people, the "owls" and the "larks".

This specific study grew out of an earlier attempt to assess hospitalized patients for their activity pattern. In this earlier attempt many of these hospitalized people, especially the women, reported that their time preferences for activity and mental alertness changed during their adult years.

They often reported being evening people or "owls" as teenagers and young adults. However, when they had children and took on other adult responsibilities they gradually changed into morning people or "larks". These reports of changing time preference raised numerous questions. Is an individual's time preference an inherent, stable biological rhythm or, instead is it an aspect of adult development? Do changing life tasks and responsibilities require the person to alter his/her time preference? If so, does the changing of a person's time preference represent adaptation to his/her changing environment? Does the reality of having to earn a living in a 9 AM to 5 PM oriented world and to deal with a child's school world of 8 AM to 3 PM force evening people to convert to a morning orientation? If people are forced to adapt as a fundamental condition for survival, it follows that they will. However, does this conversion of time preference, if it does indeed occur, represent a permanent change in a biological rhythm, or merely a superficial adaptation that will readily revert when the overriding life demands are removed?

This study primarily explored whether or not a person's time preference changes in response to changing developmental stage, with its inherent tasks and life demands, or whether it is a persistent biological rhythm. With this additional knowledge gained, nurses should be better able to assist clients to deal with life demands in their adult years, and the impact that illness, and the resulting therapeutic regimen

entails for the individual at specific stages of their development. Nurses will also be able to maximize the effects of the individual's time preference, by understanding its variability, to enhance and potentiate the individual's therapeutic regimen. Nurses now have a greater understanding of the interaction of physiologic and psychologic aspects of human beings. Specifically, greater knowledge has been gained concerning one potential coping mechanism, that of time preference, for the individual to adapt to current life demands. With this new knowledge nurses may alter their practice to purposely employ their client's time preference and adaptive abilities, with the goal of promoting their further adaptation and development.

Related Literature

Biological Rhythms-Rhythmicity

Physical and biological rhythms abound, from the annual cycle of the seasons, monthly phases of the moon, human menstrual cycles, to daily cycles of light and dark, activity and sleep. Humans once lived by the sun. Before the advent of artificial light it was imperative for individuals to work during the day and sleep at night. According to Rose (1984) this early reliance on the day-night cycle led to the evolution of two internal rhythms in humans. One of these rhythms predisposes each person to reach high activity levels during

the day. The other controls various physiologic functions in preparation for the person's daily activity. With the invention of artificial light desynchronization of this basic biological rhythm could occur at will.

Rhythmic processes in the living kingdom are ubiquitous. Claude Bernard put forth the concept of homeostasis, which contends that living organisms maintain a static, constant internal environment. Bernard's concept of homeostasis was that of a linear function, devoid of any fluctuations regardless of magnitude or frequency (Brown, Hastings & Palmer, 1970). This linear concept of homeostasis has since been modified to reflect the organism's true rhythmic status. People are in a state of continual change which consists of predictable orderly fluctuations that cause him/her to be different at different times of the day. These rhythmic patterns significantly influence his/her adaptability and the regulation and integration of both physiologic and behavioral functioning. In healthy individuals, rhythms usually show a well defined time relation to each other. It appears that a certain sequence of rhythmically changing metabolic events is essential for normal functioning and growth. The oscillations allow planning not only for the next day but really for several days, by showing anticipation of a periodic environmental event such as dawn. Just about all physiologic functions have been shown to possess circadian fluctuations, if sampled along the 24 hour scale, including: vital signs, pulmonary function,

performance, mood, coordination, short-term memory, constituents of blood, and constitution and excretion of urine (Bassler, 1978; Brown et al., 1970; Haus, Lakatus, Swoyer & Sackett-Lundeen, 1983; Moore-Ede, Czeisler & Richardson, 1983; Moore-Ede, Sulzman & Fuller, 1982).

Although circadian rhythms are the most commonly known, there are many other types. The term "circadian" was coined by Halberg of the University of Minnesota and refers to a time period of 20 to 28 hours, or about a day (Brown et al., 1970). Ultradian rhythms are more frequent than circadian, occurring most frequently in the range of 20 minutes to 6 hours. Infradian rhythms occur less frequently than once every 28 hours. Circamensual occur every 28 to 30 days and finally circannual, which occur every year (Farr, Keene, Samson & Michael, 1984; Pauly, 1983; Restak, 1984; Smollensky, Reinberg & Queng, 1981).

Site of the Biological Clock

The location of the biological or physiological clock, which controls these rhythms, is still very much in question. Richter (1965, 1967) provided the first evidence of a specific neuroanatomic site for a biological clock. Using blinded rats he subjected them to almost every type of metabolic, endocrinologic, and neurologic interference, none of which disrupted the rats' rhythms. He then placed lesions in the

brains of over 200 rats. The only lesions that resulted in a disruption in the timing of activity, feeding, and drinking were those found in the general area of the ventral hypothalamus.

In more recent times evidence points specifically to the suprachiasmatic nucleus (SCN), a tiny cluster of identifiable neurons buried deep within the hypothalamus. It has a clear coordinated rhythm of its own. Examination of these endogenous rhythms require an in vivo method. It is known that regional brain functional activity is closely correlated with regional brain glucose use. Because of this correlation, 14-labeled deoxyglucose was used in rat studies. Rats injected during their subjective (night) day demonstrated high metabolic activity in the SCN. Those injected with the same labeled glucose during their subjective night (day) demonstrated a relatively inactive SCN. These same results were found when the rats were in normal day-night environments, in constant light, or in constant darkness (Schwartz & Gainer, 1981). These demonstrable rhythms of increased glucose uptake persists after the SCN has been isolated from adjacent hypothalamic tissue by Halasz knife cuts (Moore-Ede et al., 1983).

Although circadian rhythms do not overtly express themselves in rodents until the third week of life, there is experimental evidence that, following entrainment of the mother's SCN, the fetal SCN has a circadian rhythm of its own by the 20th day of gestational life. Reppert and Schwartz

(1983) conducted two experiments using pregnant albino rats. In the first experiment, two rats were kept in constant conditions of 12 hours of light and 12 hours of darkness. At the 20th day of gestation one rat was killed during the rat's subjective day (dark period) and one during subjective night (light period). The pregnant rat and all 11 fetuses sacrificed during subjective day demonstrated very active SCNs. Conversely the mother rat sacrificed during subjective night had a barely visible SCN while the nine fetal SCNs were not visible at all. In the subsequent experiment, phase shifting was conducted on 12 pregnant rats. They found that as the mother phase shifted so did all the fetuses. Reppert and Schwartz concluded that, in rats, the mother acts as a transducer between the environment and the fetal brain, instilling circadian rhythm of activity level to the fetal SCN.

The SCN is also the receiving station of information flowing from the eyes to the hypothalamus. The optic pathways are the most important route by which environmental time cues reach the SCN. Within these optic pathways the retinohypothalamic tract, arising from specialized photoreceptors in the retina which sense ambient illumination level, forms a monosynaptic tract direct to the SCN (Moore-Ede et al., 1983). In laboratory animals, when the optic nerves are severed bilaterally, entrainment to light-dark cycles was no longer possible. When the SCN itself was destroyed and the optic pathways left intact, some clustering of daytime

activities persisted. However, if these animals with the SCN destroyed were kept in constant light or dark, circadian rhythms became desynchronized. In contrast, when the hamster's optic tract (behind the SCN) was destroyed, the animal's rhythms remained entrained to the light-dark cycle even though the animal was functionally blind (Moore-Ede et al, 1983; Rusak, 1977).

From these studies it can be concluded that, in laboratory animals, the SCN receives environmental light-dark time clues, integrates them into its internal circadian activity rhythm, and then transmits this rhythmic information to other parts and functions of the body.

Furthermore Krieger (1978) reported that of 43 conscious patients with radiographically and clinically localized hypothalamic or limbic system disease, 53% had abnormal circadian patterns. In contrast only 1 of 21 conscious patients with central nervous system disease localized outside the hypothalamus or limbic system had any abnormal circadian patterns.

Lehrer (1979) reported that individuals blinded by retrolental fibroplasia at ages less than 25 years had significantly better 10 year survival rates ($p < .05$) than those blinded from retrolental fibroplasia after the age of 65. The characteristic peculiar to retrolental fibroplasia that seems to confer the high survival rates is the high incidence of total blindness with a total lack of light perception. One

study of 962 school children with retrolental fibroplasia revealed that 45% had no light perception, while 3.2% of all blind persons are without light perception. It is hypothesized that this total lack of light perception, which occurs in retrolental fibroplasia, slows the biological clock in the SCN to more than 25 hours. Lehrer also reported that totally blinded girls are known to undergo menarche earlier than sighted or light-perceptive girls, possibly because in a child a free-running clock is less than 24 hours (Lehrer, 1979).

The SCN as the circadian pacemaker is totally logical, for it is in line to receive light and dark stimuli directly from the eye. In turn it influences control over the pituitary via the hypothalamic-hypophyseal tracts. Others have shown, however, that the SCN modifies rather than drives some rhythms. For example, work on squirrel and rhesus monkeys has shown that with destruction of the SCN, body temperature rhythm persists, yet feeding, drinking, and activity rhythms are disrupted.

Krieger, Hauser, and Key (1977) destroyed the SCN in rats and observed a loss of rhythmicity of drinking behavior, locomotor activity, and adrenal cortical activity. However, when these same animals were placed on a set two hour restricted feeding schedule rhythms were restored in body temperature and adrenal cortical activity. Further lesioning studies in squirrel monkeys, studied for up to two years in constant environmental conditions without time cues, suggest that the SCN contains, or is, the Y pacemaker, controlling

rest-activity, feeding, and drinking behaviors. Rhythms of body temperature persisted suggesting the existence of a second, X pacemaker, located outside of the SCN (Moore-Ede, 1983). Moore-Ede (1983) has also demonstrated that various in vitro mammalian tissues, specifically adrenal, heart, gut, and liver, can independently maintain circadian rhythmicity. However, the rhythms in these isolated tissues were not as precise or stable as rhythms controlled by the X or Y pacemakers. Based on this work, he concluded that the two major, X and Y, pacemakers preside over a set of secondary oscillators found in specific tissues.

Work done with human subjects has yielded results consistent with the animal studies cited above. When humans are isolated in laboratories or caves totally isolated from environmental time cues, endogenous circadian rhythms separate into two groups, which occasionally desynchronize (Moore-Ede, 1983). Rapid eye movement sleep propensity, plasma cortisol concentration, and urinary potassium excretion maintain a temporal relationship with core body temperature and have been identified as under the control of the X pacemaker, located outside of the SCN. The second major pacemaker controls skin temperature, plasma growth hormone concentration, and urinary calcium excretion, and follows the rest-activity cycle and the circadian timing of slow-wave sleep. This Y pacemaker lies within the SCN, receives environmental light cues, and is lost when the SCN is destroyed (Kronauer et al.,1982; Moore-Ede,

1983).

In human subjects studied in temporal isolation for up to six months, the X and Y pacemakers initially remain synchronized suggesting that there is a coupling mechanism between the two. Initially the free-running synchronized period is 25.3 hours. After desynchronization of the two pacemakers, the Y pacemaker establishes a 29.3 hour cycle and the X pacemaker follows a 24.5 hour period. It is believed that since X is closer to the internally synchronized free-running period than the Y, the X exerts more influence on Y, than Y on X. The coupling presumably links neural and hormonal phenomena and acts to ensure their mutual entrainment under normal conditions (Kronauer et al., 1982; Moore-Ede, 1983).

In one study, seven subjects were isolated from all known natural synchronizers in an isolation ward for 28 days. All subjects were exposed to artificial light and gong (noise) cues. Three subjects ran on schedules in which the lighting and gong cues shortened from 24 to 22 hours, while the remaining four subjects experienced a lengthening cycle to 29 hours. Core body temperature and sleep-wake cycles were monitored and subjects completed paper and pencil tests. Results indicated that simple, non-memory loaded performance is controlled by the same pacemaker responsible for body temperature or the X pacemaker. However, more taxing, memory-loaded tests were controlled by a 21 hour oscillator. The researchers concluded that performance rhythms are under the

control of at least two if not a multi-oscillatory system (Folkard, Wever & Wildgruber, 1983).

It now seems clear that circadian rhythms are controlled by a hierarchic system of oscillators that culminate in two distinct pacemakers, one of which is located in the SCN. These two major pacemakers require daily synchronization to match their respective rhythms and the 24 hour day period. In the absence of daily synchronizers the major X pacemaker runs free at about 25 hours thus desynchronizing biological rhythms from the 24 hour daily cycle. After a period of time in isolation, the two major X and Y pacemakers desynchronize from each other and rhythmic biologic functions lose their phase relationships from each other (Hofer, 1984).

Rhythm Synchronizers

To maintain an organism's optimal adaptive ability, there must be a matching of internal rhythms with environmental periodicities. In animals the most important "zeitgeber", or synchronizer, is the daily light-dark cycle. Aschoff (1965) reported that when finches were maintained in dim light their daily cycles lengthened out. Conversely when they were maintained in bright light the daily cycle shortened. Cheifetz, Gaffud, and Dingman (1968) kept rats in constant light for 56 to 90 days. These rats did not show the expected

circadian peak in plasma corticosterone. The circadian pattern was restored after a light-dark cycle was reimposed.

In subsequent studies using humans, this relationship held true. Weitzman, Zimmerman, Czeisler, and Ronda (1983) demonstrated that the sleep process has a major impact on all the hypothalamic-pituitary hormones. Six healthy young men were studied in a four day protocol consisting of one day of normal sleep, one day of total sleep deprivation, then sleep at a 180 degree shift, and finally a return to normal nocturnal sleep. During this protocol, plasma cortisol, rectal temperature, and sleep stages were monitored. They found that both cortisol secretions and body temperature significantly decreased if sleep occurs at a time when the person is normally awake. Conversely, cortisol secretions were elevated if awake at the usual time of sleeping. The authors hypothesized that the correlation between sleep and cortisol secretion is an important neurophysiologic event providing entrainment, or daily resetting, for other circadian rhythms. These researchers also point out that in pubertal children growth hormone, prolactin, luteinizing hormone, and follicular stimulating hormone are released in large amounts during sleep. In females in the follicular phase of their menstrual cycle, cortisol, thyroid stimulating hormone, and luteinizing hormone levels are decreased during sleep. Whether these changes are due to the "darkness" of sleep or other changes during sleep remains obscure (Weitzman et al., 1983).

Tom (1976) contends that although the light-dark cycle is significant in man, with the advent of artificial lighting, the most influential synchronizer became the activity-rest pattern. The activity-rest pattern is usually established by work-social schedules. Research conducted on a limited number (n=14) of blind people demonstrated that when they lived together in groups, arose at the same time each day, ate meals together, and retired at the same time at night, their circadian rhythms (temperature, peak expiratory flow, and urine epinephrine) remained synchronized (Pauly, 1983).

Operating from a different premise, Restak (1984) states that the most powerful environmental influence on biological rhythms is planetary movement. This would include planetary rotation on its polar axis (day-night), around the sun (yearly seasons), and lunar movements creating months, gravitational effects, and tidal cycles. However, he does not report any specific research to support this opinion.

Numerous authors contend that inherent physiologic rhythms (temperature, hormone secretions, peak expiratory flow, cardiac output, urine excretion, etc.) are amazingly stable and persistent (Krieger, 1978; Luce, 1971; Moore-Ede et al., 1983; Williams, 1981). They persist through the life span of experimental animals and even in many successive generations of finches reared in the absence of any environmental periodicity (Aschoff, 1965). Gwinner (1986) demonstrated that warblers and blackcaps born into and raised in captivity manifested

migratory behavior (activity and molting) identical in timing to that of birds living in the wild. These rhythms are also elaborately insulated from environmental factors, and are not affected by temperature extremes, nor by most chemical agents. In humans the circadian periodicity of plasma corticosteroids persist under conditions of: varied eating-fasting, prolonged bed rest, and up to three days of sleep deprivation. Plasma cortisol concentrations, although depressed by approximately 30%, retained their patterns in elderly subjects (Krieger, 1978; Moore-Ede et al., 1983; Williams, 1981).

Luce (1971) reports a study conducted in Italy that examined circadian rhythms and aging. This study examined "very old people" every 4 hours for their serum level of 17-hydroxycorticosteroids. Results showed a normal circadian pattern although there was a slight shift (not statistically significant) so that peak concentrations occurred earlier than in younger people. In other research, Krieger (1967) studied a group of old people in a nursing home. These subjects demonstrated the same circadian rhythm of 17-hydroxycorticosteroids as younger people. In another study, each of two groups of six healthy men, one aged 23 to 30 years, the other aged 53 to 70 years were studied in a sleep laboratory. This study found that both groups had significantly longer than 24 hour cycles for sleep-wake and temperature patterns. However the older group had a 31 minute shorter temperature cycle ($p < 0.05$) and a lower amplitude than

the younger group. It was concluded that the control of body temperature rhythm undergoes a significant change with age (Weitzman, Moline, Czeisler & Zimmerman, 1982). Lobban and Tredre (1967) studied 11 women and 13 men, ranging in ages from 64 to 88 (mean = 79) years, from two homes for the aged. These subjects were compared to 10 female and 12 male laboratory workers aged 18 to 57 (mean = 29) years. Lobban and Tredre reported that the aged subjects demonstrated normal temperature fluctuations and urinary excretion of potassium, yet urinary excretion of water, sodium, and chloride was markedly reduced. They concluded that the intrinsic mechanisms which control renal diurnal rhythms undergo some deterioration in old age. These studies certainly provide confusing and contradictory results pointing out the need for further studies, with much larger sample sizes.

Researchers have also questioned whether or not the individual's surrounding climate influences the synchronization of circadian rhythms. Lobban (1969) compared 23 equatorian born adults, 12 equatorian born children (aged 4 to 13 years), 12 adults living at the equator but born in non-equatorial latitudes, and 22 residents of London. She found that subjects in all four groups had similar temporal phasing with no significant difference in relative amplitude of urinary excretion of potassium ($p < 0.10$). Equator born subjects demonstrated a greater amplitude for the urinary excretion of water and sodium. Daily synchronization of rhythms for the

excretion of water, potassium, sodium, and chloride were "significantly better" in equatorian born subjects than for those living at the equator, but born in non-equatorial latitudes (p. 134P). Lobban concluded that environmental factors must be considered as having a role in renal diurnal rhythms. Lobban (1958) also studied urinary excretion rhythms in native volunteers in an arctic Indian village in the Yukon Territory at midsummer (maximum daylight) and midwinter (minimum daylight). She found that in half the subjects the diurnal excretory rhythms were either absent or very much reduced in amplitude in both time periods. These same findings were obtained in white subjects who had been living in the same arctic environment for some months. Based on these findings Lobban suggests that both the environment and the activities of subjects play important parts in the establishment and maintenance of physiological rhythms.

Halberg (1977) reports of a study from the University of Glasgow, in which local midnight was used as a time reference when studying the corticosteroid excretion in Scottish medical students and Indians in the South American rain forest. For the Indians the peak excretion was from 9 AM to 12 PM, while for the medical students it was from 12 PM to 3 PM. However, the two groups had identical excretory patterns when the data was re-examined using the midpoint of the habitual rest period of each group. The researcher demonstrated that using group specific time references abolishes group differences. In an

unpublished study by Blake, three groups of 12 subjects were studied for efficiency in various tasks, five times a day. All groups demonstrated a mid-afternoon dip in efficiency, regardless of whether the subject had eaten lunch at 10 AM, 12 PM, or 2 PM. This same pattern was demonstrated in subjects from various cultures and occupations (Thompson & Harsha, 1984). Thompson and Harsha explain these finding by noting that man has lived in a temperate climate for over a million years and has only relatively recently moved to arctic climates, and are therefore basically a tropic creature. Again these studies are very sketchy and contradictory, pointing out the need for larger and more comprehensive studies. Although a single specific synchronizer cannot be identified in man, numerous rhythms exist together and will now be examined.

Other Physiological Rhythms

Within man almost every physiologic function has a characteristic rhythm. Humans put in isolated underground bunkers and leading "normal lives" (3 meals, and no naps after lunch) for three to four weeks had their temperature, activity, subjective time estimation and movements in bed monitored. The results showed a clear cycle of sleep and wakefulness which was reflected in body temperature and urine excretion. The human free-running time period, however, was for 25 hours (Restak, 1984). A free-running period is the amount of time that the

normal circadian rhythms will take to complete one cycle when all environmental clues are removed. Although the circadian rhythms ran free from the 24 hour environmental cycle of light-dark, the internal physiologic rhythms remain synchronized with each other. According to Restak (1984) and Moore-Ede et al. (1983) the human free-running period is 25 to 25.3 hours. The elderly, while kept in sleep laboratories, also developed 25 hour free-running periods (Aschoff, 1965; Williams, 1981).

Experiments to study a person's circadian rhythm free of environmental influences are extremely difficult to conduct due to the stresses that the subjects experiences. Michel Siffre, a Frenchman who spent 6 months in an isolated cave in 1962 and again in 1972, compared his experiences to the technique of brainwashing. He warns that by totally isolating a person from usual time clues "you can break a man completely" (Restak, 1984, p.111).

In humans, rhythms have been documented in: blood pressure, capillary resistance, duration of the cardiac cycle, cardiac output, duration of systole and diastole, pulse, stroke volume, hematocrit, circulating blood cells, electrolytes, total serum protein, urine electrolytes, urine excretion, serum hormones, expiratory peak flow, pulmonary function test, respiratory rate, body weight, temperature, gastric acidity, and mitosis in bone marrow, among others (Halberg, 1983; Moore-Ede et al., 1983; Seaman, Engel, Swank & Hissen, 1965). Halberg (1983) reports that most deaths in surgery occur during

the middle of the rest period, as do most air accidents, while most deaths from all causes occur at the end of the rest period (early morning hours) as do most spontaneous births. With all the documented rhythms present in man it is impossible to discuss them all in detail. However selected rhythms will be examined.

Haus et al. (1983), in a rather extensive review of circulating formed elements in peripheral blood, studied male and female subjects aged 11 to 54 years over a 12 year period. Hemoglobin, hematocrit, and red blood cells peaked at approximately noon, while reticulocytes peaked at midnight to 1 AM. Within circulating white blood cells (total peaks at 12 to 4 AM) there are significant rhythms in neutrophils, monocytes, eosinophils, and lymphocytes. The neutrophils, lymphocytes, and monocytes peak early evening to early morning hours, while circulating eosinophils peak in the early morning. Platelets were found to peak at 8 PM. B cells (humeral immunity) were found to peak at 6 AM and killer T cells (cellular immunity) peaked at 12 AM. It should be noted that the peak in lymphocyte response is approximately 12 hours out of phase with the total number of white blood cells and follows approximately 2.5 hours after the peak of plasma cortisol.

Hematologic parameters follow patterns of hours, a week, a month, and a year. It is reported that red blood cells are highest on Monday and Tuesday while there are no weekly changes in white blood cells. However the total circulating leukocyte

count decreases during the bleeding span of the menstrual cycle and are increased at the termination of the cycle. Seasonal changes indicate that plasma volume increases approximately 9% during summer months with a corresponding decrease in hematocrit. Circulating leukocytes were found to be highest in December while T cells peaked in the late fall and B cells in winter (Haus et al., 1983).

As has been discussed, formed blood elements have distinctive rhythms. The reticulocytes changed 100% from peak to trough, with the smallest change being in platelets (25%) and the largest in B cells (60%). Even though these changes sound impressive it should be remembered that these elements have a wide range of normal values in healthy populations so that time qualified usual ranges do not add much diagnostic value (Haus et al., 1983).

Probably the best known rhythm in clinical nursing practice is that of body temperature. Normally temperature varies 1% over the 24 hour day. For those people active during the day the temperature is lowest when first rising, gradually rising throughout the day, peaking in the late afternoon or early evening. Even this pattern shows a seasonal variation of an hour delay in June as compared to December. Cardiac response, heart rate, and blood pressure follow the temperature curve. Blood pressure fluctuates as much as 20% during the 24 hour period. This pattern persists through exercise, eating, and emotional stimuli and is also present in hypertensives

(Kushner & Falkner, 1981; Lanuza, 1976; Restak, 1984; Rose, 1984; Tom, 1976).

In a study of six healthy males, the lowest cortisol secretion occurred during the first four hours of sleep. This pattern persists even when sleep takes place during a time when the subject is usually awake. Maximal secretion levels occur prior to or at the time of waking. It appears that the rise in steroids prepares man for waking, and activity state by offering energy and helping the individual handle stress. Patients suffering from acute and chronic illnesses and those anticipating surgery exhibit normal patterns of cortisol. It should also be noted that the circadian peak in cortisol releasing factor concentration of the hypothalamus precedes that of plasma cortisol by three hours (Bassler, 1976; Krieger, 1978; Selye, 1976; Smolensky & Reinberg, 1976; Weitzman et al., 1983).

The planetary motion of the earth creates an environment of predictable cyclic events; from the daily light-dark periods, to monthly lunar cycles, to yearly seasonal changes. It is not surprising therefore, that living organisms, including human beings, should generate periodic oscillations in a wide variety of physiologic functions. These circadian rhythms, controlled by at least two major pacemakers, synchronized by environmental and social cues, can be seen in sleep-wakefulness, hormone concentration, urine excretion, blood constituents, and body temperature, among others.

Although rhythms in the human sleep-wake pattern have been identified, a specific individual often demonstrates consistent spurts of activity during the day. Do these characteristic patterns in daily activity represent another circadian rhythm in human beings?

Morningness - Eveningness

Researchers have identified two types of people with "distinctly different circadian patterns" in regard to their rest-activity pattern, body temperature, and other physiologic rhythms (Floyd, 1984, p.255). Morning type individuals prefer to arise and retire early. They report feeling best in the early half of the day. Conversely, evening type individuals prefer to rise and retire late and report feeling best in the later half of the day (Floyd, 1984; Hoskins, 1983). Ostberg (1973) has demonstrated that these labels are a reality in terms of sleep pattern, body temperature change, and urinary catecholamine excretion. Horne and Ostberg (1976) state that 45% of 150 adults, aged 18 to 32 with an equal distribution of males and females, may be classified as either moderate to extreme morning type or moderate to extreme evening types. Additional research by Ostberg (1973), Horne and Ostberg (1977), and Horne, Brass, and Pettitt (1980) support this figure. One limitation with these studies is that they all used subjects in the 18 to 36 age range, many being university

students.

Ostberg (1973), in a study of 107 psychology students found that mean oral temperatures did not differ between morning and evening types. However, there were significant differences in the peaking of temperature. For morning types oral temperatures peaked at 2:57 PM, while evening types peaked at 5:43 PM. Evening types also started later but had a higher rate of food intake. Based on this data Ostberg concluded that the two different types have a different circadian pattern which could not be due solely to time displacement. He concluded that morning types demonstrated an autonomous 24 hour periodicity while evening types demonstrated a longer than 24 hour periodicity.

Horne and Ostberg (1977), based on a sample of 48 subjects, reported that although morning types started their day nearly two hours earlier than evening types, the evening types' peak temperature did not simply advance by two hours. They found that morning types displayed a relatively rapid waking temperature rise resulting in a plateau. This plateau is terminated in a slight but obvious peak at 7:30 PM. In evening types a steady temperature rise throughout the day was observed, reaching a distinct peak at 8:40 PM. The rate of temperature decline was similar, with evening types lagging by one hour. These two researchers significantly correlated their morningness-eveningness classification with peak temperature time, bed time, and arising time.

Horne, Brass and Pettitt (1980) in studying 20 subjects, aged 18 to 30 years, performing a simulated production line inspection task found a statistically significant performance difference between morning and evening types over the time of day. The greatest difference in performance was found in the morning and least in early afternoon. A high positive correlation (r= +0.89) was discovered between task performance and body temperature in evening types but a negative correlation (r= -0.81) in morning types. These researchers concluded that there was no causal relation between the circadian rhythms of body temperature and performance but just the existence of separate, but concomitant rhythms.

Horne and Ostberg (1976), and Floyd (1984) report that although timing of sleep differs, the total amount of sleep time is the same. It has been reported that morning and evening people differ in how easily they each adapt to changes in their sleep-activity patterns. Morning type individuals have a great deal of difficulty in altering their sleep patterns. Because of this difficulty morning people have a great deal of trouble adapting to evening or night work. They usually transfer out of such shift work. In contrast, evening types have been found to more readily adapt to shift work and other changes in their daily schedules (Akerstedt & Froberg, 1976; Foulkard, Monk & Lobban, 1979).

All of the previously cited findings were supported by a study conducted by Foret, Benoit, and Royant-Parola (1982). In

this study 49 medical students, aged 19 to 23 years were classified, using Horne and Ostberg's questionnaire, as morning, evening, or neither types, and kept logs for two weeks recording their daily schedule, body temperature and level of alertness, every three hours while awake. Foret et al., reported that sleep schedules were significantly different between groups. All groups modified their sleep schedules during vacations, evening types significantly more that the morning type subjects. Morning types experienced peak alertness 3.6 hours earlier than evening types and had a peak body temperature 1.2 hours earlier. Only the difference in peak alertness was statistically significant ($p < 0.001$). These authors concluded that peaks in body temperature are less dependent than that of alertness on the extent to which subjects are morning or evening type individuals.

Froberg (1977) studied 16 females, half evening and half morning types. aged 21 to 47 years chosen from a pool of 47 potential subjects. The 16 actual subjects scored clearly morning or evening type on a morningness-eveningness questionnaire. Froberg found that evening subjects were younger, aged 27 to 37 years with a mean of 34.3 years. Morning subjects aged 31 to 47 years with a mean of 44 years. All subjects were kept together in a large room, each seated at an individual table, isolated from all time cues, and kept awake for 72 consecutive hours. Each subject took the same five paper and pencil tests, with only the ordering changed,

every three hours. Following two hours and 45 minutes of test taking there was a 15 minute break for eating a sandwich and toileting. None of these subjects were aware of this three hour periodicity. Of the five paper and pencil tests (vigilance, complex cancelling, spiral maze, syllogisms, and self-rating of wakefulness, low arousal, tenseness, and stress) only in self-ratings of wakefulness, low arousal, and tenseness was there a significant difference in groups. On all three days of the study, significant differences were found in the vigilance task. For both morning and evening type subjects the best performance was during the day. A similar pattern was found with the complex cancelling task but differences were significant only on days two and three. Neither group demonstrated any consistent patterns in the spiral maze or syllogisms tests. The self-ratings for wakefulness and low arousal showed statistically significant 24 hour patterns, on all three days for the morning group, while the evening group demonstrated a flatter and less pronounced pattern. The evening pattern was significant only on the first day. Morning subjects also scored higher in self-ratings both in the morning ($p < 0.01$) and in the evening ($p < 0.05$). Froberg concluded that there were no significant difference between the morning and evening groups as concerned individual estimates of best time of day as found in other studies. Froberg attributed the absence of a difference to the fact that this study deprived subjects of sleep for 72 hours thus depriving them of their

natural synchronizing schedules.

Floyd (1984) investigated the interaction of psychiatric patients' rhythm of sleep-activity and the rest-activity schedule of a hospital. Based on a morningness-eveningness questionnaire, a self-reported sleep chart, and a chemical substance record collected on 35 inpatients and 35 outpatients, she found that: 1) human beings experience shorter, faster rhythms during periods of environmental change, 2) morning type rhythms were not congruent with hospitals' established rest-activity schedule, 3) the length of phase delay in the sleep-wake cycle was greater for evening types, 4) morning types had more trouble coupling their sleep-wake cycle with a new environmental rest-activity cycle, and 5) the hospital rest-activity rhythm functions as a strong temporal organizer of sleep and wakefulness. She concluded that evening types could adjust to much greater shifts in sleep-wake cycles as easily, if not easier than morning types can adjust to much shorter shifts in sleep-wake cycle. Horne (1986) writes that his personal perception is that evening types are far more adaptable to becoming morning types than morning types becoming evening types. Is this because "owls" are inherently more flexible than "larks" or because they must adjust to survive in a morning oriented world?

But is an individual's time preference a true circadian rhythm or is it simply a response to life demands? Luce (1971) wrote:

> Subjectively, people do notice that they are changing during the 24 hours of the day. Some people express this by their preference for afternoon or morning work, or may notice that they are emotionally resilient at certain hours and irritable at others. Like mechanical clocks, we synchronize our activity with the imperatives of society around us, and squeeze ourselves into the 24-hour schedule of modern life. (p. 2).

Yes, people do subjectively notice consistent differences in their mental alertness and energy level each day, yet no one subjectively notices variations in hormone level, body temperature or blood and urine constituents. Do all biological rhythms have to go unnoticed? Or could this mean that a person's subjective activity and alertness is an adaptive response to societal demands, and not be a biological or circadian rhythm?

Lanuza (1976) reports that the individual's peak mental and physical performance and favorite time of day coincide with the individual's temperature curve. Yet Winget, DeRoshia and Holley (1985), after analyzing numerous studies correlating performance with circadian body temperature patterns state that this correlation fails to hold following transmeridian flight, during the post-lunch performance dip, during which body temperature continues to rise, and with high memory-loaded tasks. These authors contend that the most probable explanation is that both body temperature and performance are

independent functions controlled by a common pacemaker. They also offer an alternate explanation that performance rhythms are the consequence of, yet uncovered, rhythmic changes in arousal. Yet could it not be just as plausible that performance rhythms vary with arousal cues from the environment? If this is so, then performance rhythms and time preference are not biological rhythms but rather dependent on ever changing environmental and societal cues and demands.

Foret et al., (1982) and Horne and Ostberg (1977) found only a 65 minute difference in body temperature peak time between morning and evening type individuals. Yet Winget et al. (1985) report that a Russian study found that the timing of mood and activity rhythms differs by several hours between distinct morning and evening type individuals. Again this intimates that morningness/eveningness type is not a true circadian rhythm, or at the very least not dependent or correlated to the circadian rhythm of body temperature. Conversely Patkal (1971), in examining the adrenalin secretion in humans following various work schedules, found that workers who are morning types, are at work and active early in the day, secreted significantly more adrenalin in the morning than evening type workers. This data may provide a circadian hormonal basis for morningness/eveningness time preference. Yet, it is still unresolved whether the higher adrenalin levels cause the `morningness' or whether a nonbiological time preference created the met need for higher

morning adrenalin levels.

With all the data available it cannot be disputed that there are groups of people with distinctly different time preferences. Yet the question of whether these time preferences are an inherent biological rhythm or not is still open to debate. No study has ever been undertaken that comprehensively examines biological rhythms (urine constituents, blood constituents, hormonal levels, menstrual cycles, illnesses, births, etc.) among morning types as compare to evening types. Although people have reported changes in their time preference as they age, whether or not they actually do, or whether these preferences can be disrupted has never been systematically studied, nor has biological rhythm desynchronization, which will now be discussed.

Desynchronization

Although it was previously stated that biological rhythms are remarkably stable, they may be desynchronized. Humans living under the abnormal conditions of not having any light-dark cues in the Arctic Ocean, were presented with clocks that ran fast or slow. These people consciously changed their activity to fit the clock time. However physiologic functions (body temperature and concentration of urinary electrolytes) did not readily change resulting in phase shifts and desynchronization of rhythms. When rhythms were disrupted

subjects experienced feelings of fatigue, imbalances of homeostatic mechanisms, and decrements in performance (Bunning, 1973; Lanuza, 1976).

Kleitman (1970) used himself as a subject in an attempt to live a 28 hour day during a month's stay in an isolated cave. He reported that he was always out of step with the artificial 28 hour period. Kleitman was sleepy when he should have been alert, and not hungry at meal times. One of Kleitman's students, 20 years his junior, replicated Kleitman's experience. The younger man did adapt to the 28 hour day, as measured by sleep and eating patterns, and subjective reports. Weitzman, Kripke, Goldmacher, McGregor, and Nogeire (1970) had men live in a hospital metabolic ward for nine weeks. All subjects had around the clock measurements for EEG, temperature, urine and blood constituents. Also, one day each week blood and urine samples were taken every four hours to monitor cortisol, insulin, sodium, and potassium levels. After three weeks of baseline measurements all subjects were kept awake all night and allowed to sleep only during the day for the next three weeks. For the final three weeks of the study the subjects returned to a normal, sleep at night, schedule. Results demonstrated that body temperature did not move into the altered rest-activity cycle until the end of the second week. When the subjects returned to their normal schedule, body temperature moved back into phase in two to three days. This finding suggests that the original phase shift was

superficial. The other parameters shifted at different rates, with cortisol not shifting to the new rest-activity cycle even after two weeks.

A single subject, who spent 105 days isolated in a cave, demonstrated that although a usual, 24 hour schedule was attempted during the first three weeks, this schedule became longer and longer averaging 24.71 hours. During the total time in isolation, this subject's time of maximal urinary excretion of potassium progressively lengthened, demonstrating a period of slightly longer than 24 hours. Also during the first eight weeks of isolation urinary excretion of sodium, chloride and potassium were similar and regular. Following the initial eight weeks, and for the remainder of the experiment, the excretion of sodium and chloride remained synchronized. However chloride and potassium excretion became increasingly irregular and totally out of phase with each other (Mills, 1964).

In the only specific nursing study found, 11 women who had undergone abdominal surgery reported that surgery and hospitalization induced changes in basic circadian patterns, although rhythms appeared to normalize during the hospital period. The authors would not commit themselves to state whether the disruption in rhythmicity delayed recovery or not (Farr et al., 1984). In other studies, well adjusted night workers took between three to six weeks to readjust to normal rhythms. Other night workers demonstrated less efficient

performance and suffered psychological and physiologic disturbances, having most industrial accidents at 3 AM. These individuals are constantly experiencing a conflict between social and work synchronizing cues (Aschoff, 1965; Haus et al., 1983).

Summary and Conclusion - Rhythmicity

Biological rhythms have been demonstrated in a wide variety of organisms, from simple bacteria to complex human beings. In humans, circadian rhythms are seen in hormone secretions, constituents of blood and urine, body temperature, mental alertness and performance, and activity, to name just a few. The biological clock thought to control these rhythms is felt to be located partly, but not solely, in the SCN. The SCN receives environmental light-dark cues enabling it to synchronize all body functions. In animals, the most significant synchronizer is the daily light-dark cycle. In man it is not known whether the light-dark cycle or work-rest pattern is the most significant rhythm synchronizer, nor how influential environment may be.

Two types of people have been identified with distinctive circadian rhythms in mental alertness, performance, activity, food intake, and body temperature. "Larks", or morning people, arise early and get right to work. "Owls", or evening people, like to sleep late and become alert and most active late in the

afternoon or evening. It has also been demonstrated that physiologic rhythms can be disrupted or desynchronized in humans by altering sleep-wake cycles, time cues, or time zones.

Much of the research reviewed in the area of biological rhythms was conducted on laboratory animals. It is not possible to study generations of humans living in a constant (total light or total dark) environment, nor create lesions in the human brain. For those studies that were conducted with humans, relatively few subjects were used. Very serious ethical issues are raised when considering studies that would subject humans to isolation for long periods of time. As Siffre pointed out, these conditions are tantamount to brainwashing. In other studies, subjects are kept in sleep laboratories for weeks, isolated from families, friends, and usual activities. It is very difficult to recruit large number of subjects in studies such as these. Because of the controls employed in experimental research, internal validity may be assumed. However external validity, specifically the generalization of animal studies to humans cannot be assumed, and must be viewed as a weak link in this discussion. These questions will lead to a great deal of future research.

Two different types of individuals with distinct activity patterns have also been identified. The question has been raised whether this activity pattern represents a biological rhythm or a response to life demands with their concomitant environmental cues. The issue of life demands and adult

development will be explored in the next section.

Adult Development- Introduction

Growth and development are two separate processes. "Growth refers to increase in body size or changes in structures, function, and complexity of body cell content, and metabolic and biochemical processes up to some point of optimal maturity" (Murray & Zentner, 1979, p. 2). "Development is the patterned, orderly, lifelong changes in the structure, thought, or behavior that evolve as a result of maturation of physical and mental capacity, experiences, and learning and result in a new level of maturity and integration" (Murray & Zentner, 1979, p. 2). The two processes do not necessarily occur together. An organism may grow without developing, or may suffer from stunted growth yet fully develop in other aspects.

Development, the process that will be explored here, permits the person to adapt to his or her environment by either controlling the environment, or controlling responses to it. Developmental processes involve an interplay among the physiological characteristics, the environmental forces (including societal and cultural that act upon the person), and the psychological mechanisms that mediate between them. Development combines growth, maturation, and learning, and involves organizing behavior (Murray & Zentner, 1979).

According to Sheehy (1974), development incorporates both

an external and internal realm. Sheehy's external realm is composed of our culture, job, social class, family, social roles, and how we present ourselves to and participate in the world. She identifies her interior realm as the meaning our participation in the world has for each of us; how congruent our values, goals, and aspirations are with our life situation; and how we feel about our way of living.

Sheehy (1974) states that: "while each of us is continually growing up or growing old, the interior life system has its own stubborn idiosyncratic clock" (p. 36). It is this inner realm where the cues signalling the necessity to change and move on to the next developmental stage originate. One might wonder whether this inner realm also incorporates the genetic and physiologic milieu, including biological rhythms and time preferences?

Until recent years it was thought that development of a human being occurred through childhood into adolescence and was completed before the beginning of adulthood. This idea found its roots in Freud's pioneering work on adult psychoses which he attributed to disturbance(s) prior to, or during the Oedipal period. It was not until 1959 that this view was contradicted. At this time one major theorist, Erik Erikson, published his work Childhood And Society, which outlined eight stages of human development. Three of these stages occur in late adolescence through adulthood. This revolutionary idea was subsequently supported by Daniel Levinson a psychologist, Roger

Gould a psychiatrist, and Bernice Neugarten a sociologist and gerontologist. Both Erikson and Levinson view adult development as proceeding linearly through a series of stages, each of which possess certain tasks to be met. Gould, believes that adulthood, as a developmental period, has been conceptually and empirically ignored in the psychiatric literature. His work is based on the assumption that people continue to change over the period of time considered to be adulthood and that developmental phases may be found during the adult span of life if they are looked for properly. He contends that biological changes continue throughout life, therefore the person should continue to develop. Neugarten finds the lifeline to be punctuated at various points by major psychological or social events which serve to divide the lifespan into periods of infancy, childhood, adolescence, young adulthood, middle age, and old age. In each of these time periods adaptations are different (Barnett & Baruch, 1978; Gould, 1972; Prock, 1975). Gail Sheehy (1981) summarizes by writing: "Our personalities do not stop developing at the end of adolescence. Each time we move from one stage of our lives to the next we face a transition..."(p. 2).

Developmental Assumptions and General Principles

Behaviors change depending on the stage of development. Murray and Zentner (1979) outline nine assumptions concerning

human behavior. 1) The person is a unified but open system made up of components of body, mind, feelings and spirit. These components are continually influenced by the environment and in turn the person influences the environment. 2) All people are similar and share the same basic needs, yet they are unique in following and expressing their own developmental patterns. All people, because they are all homo sapiens, are more similar than different. 3) The person is a unified whole. Thus understanding of the person is not possible through study of isolated components. 4) The person's life process evolves irreversibly. Consciously or unconsciously, the person is influenced by his\her past. 5) The person responds as a total organism in terms of his\her own perceptions, needs, and expectations. 6) Each person is a social being and can function in the social system and its institutions. 7) The person cannot understand the self without understanding others, and he\she cannot understand others without understanding the self. Understanding our past and our parents help us to understand the self, since developmental patterns of the parents are repeated in the child. 8) Culture and society determine guidelines for normal progression of development and behavior patterns. Deviations from normal may occur in all or in only certain areas. 9) Throughout life, the person strives to reach optimal physical and emotional potential. An inner motivation drives him\her onward to meet various developmental tasks.

These same authors delineate eleven principles of human development. 1) Childhood is the foundation period of life. Attitudes, patterns of behavior and thinking, and personality traits established in the first five years determine, to a large extent, how successfully the person will continue to develop and adjust to life. Early patterns of behavior persist throughout life. 2) Human development follows definable, predictable, and sequential patterns. Development occurs continually through adulthood. Everyone progresses through similar stages, but the age of achievement varies, depending upon inherent maturational capacity interacting with the physical and social world. The different aspects of growth and development (physical, emotional, social, and spiritual) are all intertwined, proceed together, and affect each other. Stages of development overlap, with gradual transitions from one to another. 3) Growth and development are continuous, but occur in spurts rather than in a linear direction. 4) Growth is not necessarily accompanied by development. 5) Critical periods in development occur when various aspects of a person's physical and psychosocial growth experience a rapid spurt. 6) Mastering developmental tasks of one stage forms the basis for mastering the next developmental stage. Certain time periods exist when the tasks can be accomplished, and the task should be mastered then. If the time is delayed, the person will have difficulty mastering the task. Each developmental stage has characteristic traits, a period of equilibrium when adjustments

occur more easily, and a period of disequilibrium, when difficulty in adjusting is experienced. Developmental hazards exist in every stage. 7) Increasing differentiation of the self from the environment is the result of increasing self-knowledge and autonomy. 8) The developing person acquires competencies in four major areas, physical, cognitive, emotional, and social. These four areas constantly influence one another. 9) Readiness and motivation are essential for learning to occur.

Although these are general principles, many factors contribute to the formation of permanent personal characteristics and traits including genetics, prenatal environment, family, society, nutrition, physical environment and intellectual stimulation. Untimely events (financial reversal, marriage that does not occur when hoped for, etc.) can upset the sequence and rhythm of the expected developmental process. Similarly if life accidents (war, death of a loved one, etc.) occur during a transition from one stage to another, it forces the person to face the issues and tasks of that transition (Murray & Zentner, 1979; Sheehy, 1974). This concept of untimely events was supported by findings from a series of intensive interviews from 20 women (Hancock, 1985). It was reported that the women felt grown up only after they had faced a crisis in a significant relationship. These women ranged from 30 to 75 years of age, and had diverse social, family, educational, and occupational backgrounds. These

subjects reported that the crisis forced then to find a purpose that places them at the center of their own lives. Hancock (1985) believes that as the woman faces a transition, she abandons old assumptions about life and forges a new framework for life, in which the self is now important and cared for.

Developmental Theorists

The most prominent view of the life cycle and of adult development comes from the field known broadly as "depth psychology" which was founded by Sigmond Freud. Freud created a theory of personality encompassing the conscious and the unconscious. He showed how personality development in childhood profoundly influences one's life in adulthood. He worked on the theoretical premise that the major groundwork for the individual's emerging personality is more or less determined by the time a child reaches the age of five, and that sexual desires are the primary motivator of behavior. He regarded adulthood primarily as a scene in which the early unconscious conflicts were re-enacted, rather than a time of further development (Freud, 1966; Levinson, 1978).

Carl Jung, an associate and student of Freud, is given credit for being the father of the study of adult development by originating the field of social psychology. He understood that individual development was a product of both internal psychological processes and exterior cultural forces. His

subsequent work was based on the clinical study of patients and the analysis of ethnography, mythology, and symbolic creations from many cultures and historic periods. Jung's theory put forth that the young adult, as part of normal development is still highly caught up in the emotional involvements and conflicts of childhood, and that the unconscious mind and past experiences are important in determining behavior. At this point he is hard pressed to cope with the demands of family, work, and community. He felt that the personality cannot reach its full growth by age 20 and that "individualization" is the developmental process that begins at age 40 and extends over the last half of the life cycle (Jung, 1931, 1968; Levinson, 1978).

Erik Erikson is the seminal author cited by subsequent researchers in the field of adult development. Erikson outlined eight stages in human development. Each of these stages is marked by a "crisis" which is a turning point. During this crisis there is a crucial period of increased vulnerability and heightened potential for further growth and development. The first four stages, basic trust vs. mistrust, autonomy vs. shame and doubt, initiative vs. guilt, and industry vs. inferiority cover the early and middle childhood. The fifth stage, identity vs. role confusion occurs during adolescence and terminates at early adulthood. During this stage the person is forming his ego identity, identifying an adult role, forming his sexual identity and experiencing

adolescent love. Intimacy vs. isolation is the sixth stage and the first clearly occurring during the adult years. This stage, arising in the 20's, is when the person gains the capacity to commit himself to affiliations and partnerships. Also he develops the ethical strength to abide by these commitments, even if they call for significant sacrifices and/or compromises. The seventh stage, generativity vs. stagnation, usually occurs during middle adulthood or the 40-50's. At this time the mature adult feels a voluntary commitment to guide the next generation, children or younger associates. The last of Erikson's stages, ego integrity vs. despair, usually occurs in late adulthood or the sixth decade of life. At this stage, the person has taken care of goals he previously set and has adapted himself to life's triumphs and disappointments. He finally accepts his life as his own and would wish for no other life. He would defend the meaning and the dignity of his life-style. His life experiences have given him wisdom, and an enriched perspective about life and people. If all tasks have been successfully completed death loses its sting (Erikson, 1963; Levinson, 1978). Although Erikson presented developmental stages that encompass the entire life span from childhood through adulthood, he concentrated on the childhood stages, and merely skimmed over the adult stages. Erikson also based his developmental stages on work with male children. After originally publishing his developmental stages, Erikson wrote that they were slightly different for

females. For females, their identity is not formulated until she has married and has taken her mate's name and status. While the male forges his identity in relation to his world, the female forges her identity by forming an intimate relationship with another person (Erikson, 1968).

Daniel Levinson, a psychologist from Yale University, expanded upon Erikson's work. Levinson studied 40 American born males aged 35 to 45 years in age. These subjects were equally divided among hourly industrial workers, business executives, college biologists, and novelists. Based on extensive interviews with these men, Levinson breaks down the adult years into three broad phases: early (17-45 years), middle (40-65 years), and late adulthood (60-? years). Each era lasts about 25 years and overlaps so that a new phase is getting under way as the previous one is being terminated. Within each broad phase there are subcategories.

Early adulthood, ordinarily beginning at 17 or 18 and terminating at 45, may be the most dramatic of all eras. During this time the person reaches both the peak of his biological functioning, and intelligence. It is the era of greatest biological abundance and of greatest contradiction and stress. Early adulthood starts with the novice phase during which the person is faced with four major tasks: 1) forming a dream, and giving it a place in his life structure, 2) forming mentor relationships, 3) forming an occupation, and 4) forming love relationships, marriage, and a family. Although not as

major, other common tasks to be accomplished include, relating to authority and gaining greater authority, forming peer relationships, relating as an adult, and forming adult values and outlook.

One subcategory of the early adulthood phase is the early adult transition, which allows the person time to terminate his adolescent life structure and make preliminary steps into the adult world. During this time he moves from his family of origin, assumes new roles, and becomes less financially dependent. From the ages of 22 to 28 the person is entering the adult world and facing the major task of fashioning a provisional structure that creates a workable link between the valued self and adult society. He makes and tests a variety of initial choices regarding occupation, love, relationships, values, and life styles. He examines a variety of alternatives while increasing his commitments and searching for a stable life.

The age thirty transition provides the opportunity for the person to work out flaws and limitations formed earlier. Usually life takes on a more serious tone at this time. Early adulthood culminates in settling down, or building a second life structure. At this point he is faced with the major tasks of establishing a niche in society and striving for advancement. He is investing himself in the components of his life structure, work, family, or community. By the end of this period he feels that he has "become his own man" (Levinson,

1978, p. 60).

Between the ages of 43 to 48 the male enters middle adulthood. He has developed a less driving attitude and is more realistic about goals and accomplishments. For some this is the most fulfilling and creative period of life, while for others it is very constricting and marks the beginning of the end. All life structures are again questioned, and new choices tested leading to a basis for a new life as he comes to terms with the past and prepares for the future. During this time he is faced with three major tasks: 1) reappraise the past and terminate the early adulthood phase, 2) take the first steps toward middle adulthood by modifying the negative effects of the earlier years, and 3) deal with the polarities that create deep divisions in his life. The central issue at this time of life is one's own mortality which causes a turning toward the self more. This is also the basis for the polarities to be resolved: young vs. old, destruction vs. creation, masculinity vs. femininity, and attachment vs. separateness. The male, although very capable, begins to feel a slow biological decline and a beginning threat of death. This is also a time of ripening wisdom, judiciousness, magnaminity, unsentimental compassion, breadth of perspective, and a tragic sense. During the ages of 50 to 55, life structures are modified. Ages 55 to 60 mark the completion of middle adulthood and a time of great fulfillment. The late adult transition at age 60 to 65 marks the termination of middle adulthood and is a major turning

point in life.

Late adulthood, from age 65 on, is a time of numerous biological, psychological, and social changes but is a distinctive and fulfilling era. The person retires and can do and be what he wants. He becomes less interested in the rewards of society and more interested in his own inner resources and rewards.

Levinson, in his work on midlife men found that chronological age was a core variable in organizing and understanding the events of adult development. His three eras or periods occur in a fixed sequence, although developmental blocking can occur. Each era is intertwined with other eras but the current era predominates (Levinson, 1978).

Gail Sheehy (1974), following the footsteps of Levinson, studied 155 healthy, motivated, middle class males and females aged 18 to 55. Middle class subjects were chosen because they were not seen as being bound by tradition or poverty. The men studied were professionals, top and middle executives, politicians, and students. The women were top achievers and traditionally nurturing women. Over half were divorced and came equally from Protestant, Catholic, and Jewish backgrounds. She found that before the age of 18 the individual is safely part of his or her family of origin. He/She may feel autonomous at times, but this is subject to change from moment to moment. After age 18 the individual "pulls up roots" and begins to leave the intimate circle of family and enter the

adult world by becoming part of a peer group, taking on a sex role, identifying an anticipated occupation and forming an ideology or world view. The individual usually begins by knowing what he or she doesn't want to do and vaguely knowing what he or she does want to do. During the "trying twenties" the person learns how to take hold in the adult world. If possible a mentor is found. He/She forms the capacity for intimacy. The individual does what he "should" as defined by family, society, or peers, and feels that whatever choices were made are irrevocable. One of two impulses hits the person at this time. He/She may begin to build a firm, safe structure for the future by making strong commitments setting in motion the locked-in life pattern or exploring and experimenting, and setting in motion the transient state life pattern. The "trying twenties" is one of the longer and more stable periods.

An individual experiences the catch 30 passage from ages 28 to 33. At this time a restless vitality swells up so that the person begins to think about what he/she wants to do rather than what he/she should do. Often the life built in the 20's is torn up. Although this is a true crisis period, the person does make a definite choice of vocation. The deadline decade sets in between 35 to 45. At this time the individual feels the squeeze of time. Most experience an authentic crisis. Men especially feel that time is running out. Career position and financial status became significant, while health status becomes an important age marker. Women are more likely to see

a realm of unimagined new opportunities. An initial sense of danger and timidity yields to invigoration. For both sexes all notions of what the future holds needs to be rebalanced around the idea of how much time is left to live. This upheaval from 35 to 45 is popularized as the "mid-life crisis".

As people move into middle age (45 years), most find renewal. People most commonly report increased security, finding it easier to relax, not being as concerned what other people think about them, and are less competitive and compulsive. Often the 50's are the happiest time of their lives. They find the greatest delight in their love partners. The person finally gives himself permission to do the things he/she likes to do, as well as what he/she should. The major task for the 50's is saying "I am who I am" (Sheehy, 1981, p. 64).

Older personalities are far more distinctive then they were as young adults. People in their 60's, who maintain an excitement about life, feel a detachment about concerns that used to concern them. They also feel a greater intensity about doing things that are important to them, and they now know what is important. Healthy and happy 70 year olds demonstrate two overriding similarities. First they are active in their communities, and have made themselves independent. Second, they are always planning ahead, for at least five years. The task for those beyond the seventh decade of life is to resist a retreat into self-absorption, yet detached contemplation is

natural and satisfying at this decade (Sheehy, 1974).

Roger Gould (1972), a psychiatrist at the University of California at Los Angeles, supported these findings. In observing patients he concluded that the main focus for 16 to 18 year olds was a wish to "get away from parents", but no action was connected with this (p. 525). From 18 to 22 the person starts to feel himself halfway out of the family. Peers are very supportive as their autonomy is being established. The ages 22 to 28 contain considerable shift. They feel quite established, autonomous, and independent. They have set their life course and expend energy on mastering what they are supposed to do. Marriage and career lines are established from 29 to 34. Young children are growing just as some inner aspect is striving to be addressed. Now the major question is: "Is what I am the only way for me to be?" (Gould, 1972, p. 525). As the person ages to 50 the "die is cast" feeling is present. Social activities are sought but they tend to be superficial and competitive as the person senses his/her finiteness and tries to demonstrate their worthiness. After the age of 50 there is a mellowing and a warming up. There are renewed questions about the meaningfulness of life as the pressure of mortality is heightened (Gould, 1972).

Although these various theorists use different terms and slightly different cut off points they are amazingly similar. Erikson's stages of intimacy vs. isolation corresponds to Levinson's early adulthood phase, Sheehy's novice phase, trying

twenties, and the catch 30 passage, and Gould's years 18 through 28. The person leaves the family of origin, forms his/her own family and does what he/she "should" do. Generativity vs. stagnation, Erikson's second adult stage corresponds with Levinson's middle adulthood, Sheehy's deadline decade, and Gould's years 29 through 50. The individual pursues what he/she wants and feels he/she must do. Finally integrity vs. despair, older adulthood, the comeback and subsequent decades and the years after the age of 50 all correspond. These are the decades when the person mellows, and faces declining capabilities and his/her mortality.

All of the major work on human development does contain major limitations. Freud based his theory primarily on sick personalities to whom he was providing psychiatric treatment. He looked for the causes of present behavior in the past, ignoring that there are well adjusted adults who have survived impoverished childhoods. Erikson's theory is based on the male child. This is especially evident in his fifth stage of identity vs. role confusion. For men, identity precedes intimacy and generativity, while for women intimacy precedes or is fused with identity. For the male, and in Erikson's model optimal identity formation is gained through separation and individualization. Yet work by Pinch (1981) and Gilligan (1982) show that women form an identity as she knows herself, forms intimate relations, and is known through her relationships with others. Barnett and Baruch (1978) further

point out that, for women who have children, issues of personal identity often do not become critical until child-rearing responsibilities diminish, often not until the women's late 30's or 40's.

Levinson's study used only a small (n=40) sample of men. Perhaps because of this Levinson's model does not fit the experiences of many women. Zubrod (1980) found that for a women, the age 30 transition centered more on increasing autonomy and a related sense of responsibility to the self. Furthermore Zubrod found that the process of becoming is more of a conflicting process for women than for men because of a fear of losing their femininity and valued relationships. Nolan (1986) also points out that Levinson's work focuses on the male role of husband and wager-earner. However this model does not take into account the multiple roles that women fill including wife, mother, homemaker, and wage-earner among others. While a man typically enters the work force in his 20's, a woman often enters marriage, and has children before entering the work force in her 40's. Both Erikson's and Levinson's models develop linearly, with a large focus on chronological age.

Sheehy followed the earlier work by Levinson, copying his research design, but correcting some of its limitations. She almost quadrupled the sample size (n=155) and studied both males and females. Yet Sheehy is a journalist and published her findings in a popular book, not subjecting it to the rigors

of academic review. However she examined the development of women following different roles (i.e. mother, worker, super-achiever, etc.) across 38 years of their lives, something which no other researcher has done.

Reinke (1985) analyzed data presented by Harris (1985) and found supportive evidence for Sheehy's findings. Retrospective interview data were collected from 124 women recruited from a random sample of middle-class suburban women from the mid-west. The sample ranged in age from 30 to 60 years. Each interview was conducted to gain a comprehensive history of what had occurred in each subject's life since high school, including her reflections on experiences in terms of thoughts, feelings, attitudes, hopes, plans, and motivation. Reinke, using a Chi square test found that major psychosocial transitions were not uniformly distributed by age, but rather "commenced between ages" (p. 260). Reinke's first transition occurs at age 27 through 30. The women reassesses her life, with increased focus on self, increased involvement in hobbies and depth of friendships. At this time the women set new personal and educational goals. This supports Sheehy's finding of the catch-30 transition in which the person reassesses her life and begins to think about what she wants to do rather than what she has to. In their 40's Reinke reports that her subjects were more mellow, more accepting and not bothered by the little things in life. Similarly Sheehy reported that people felt more relaxed and secure, and less competitive and compulsive

during their fourth decade. During the 50's Reinke found her subjects to have greater inner stability and satisfaction with life. Sheehy also found this to be the happiest time in their lives. Finally, in their 60's Reinke's women became more assertive, more expressive of opinions, yet more mellow and patient. Sheehy found her subjects age 60 and older to be more detached from concerns that use to bother them, yet they are also active in their communities and planning ahead with detached contemplation.

It is well established by the authors cited above that human beings continue to develop and change throughout their life span. From Floyd's (1984) work we know that human's experience shorter, faster biological rhythms during periods of environmental change. Do changes in the individual's psychological environment also change the individual's rhythmicity? Does changing from one developmental stage to another represent a psychological stage? In an informally conducted survey of hospitalized patients, women especially, reported being evening types during their childhood and early adulthood. However they reported that they were morning types now because of child-rearing and job responsibilities (Forbes, 1986). Ostberg (1973) has previously shown that morning type individuals demonstrated an autonomous 24 hour periodicity while evening types demonstrated a longer than 24 hour periodicity. Does the change from a childhood/adolescent stage to an adult developmental stage represent a changing

environment? If this is true then a change in a person's rhythmicity may represent an adaptation to this environmental change. Do the multiple roles that a women has affect her rhythmicity? The specific pattern of women's roles will now be examined in more depth.

Women's Life Patterns

The link between theoretical and empirical work on women in middle age is very weak. Underlying many of the earlier studies of middle age women is a belief in the biological determinism of feminine behavior. These studies have assumed that: 1) the mind-body relationship for women is somehow closer than for men, 2) biological influences are stronger for women than for men, and 3) work and/or retirement is not as important in the women's life as the man's. Therefore these studies tended to see a women's life only in terms of her reproductive role, menopause, or resolving the "empty nest" dilemma. The only things viewed as crucial to a women's well-being are marriage and children (Barnett & Baruch, 1978).

Sheehy (1974) stated that "I observed more outer restrictions and inner contradictions for women during the first half of life... Quite the reverse is often true in the second half of life..." (pp. 22-23). Women are more willing to disclose themselves and their openness to change. "One comforting thought to keep in mind is that you can always

change your mind, and your pattern. Women have long lives with many seasons." (Sheehy, 1974, p. 295).

Sheehy (1974), based on her research, found five distinct life patterns: caregivers, either-or, integrators, never marrieds, and transients. The caregiver type women marry in or by their early 20's. At the time of marriage they have no dreams of going beyond the domestic wife and mother roles. Because they elect to be auxiliaries to their partner, they end up living their ambitions through others. Although this is the most popular life pattern for women, by 40 most of these women find that marriage just isn't enough and they suffer a true midlife crisis. They return to school or obtain an extrafamilial job, often in areas that are an extension of their caregiver skills.

The second life pattern is that of either-or females. These women feel that in their 20's they must make a choice between love and children or work and accomplishments. The nurturer chooses to defer achievements and seeks marriage and starting a family. Identity diversion characterizes the early part of this pattern. She will have a great deal of inner preparation to do before she can clearly pinpoint her career goals, which will eventually surface and be fulfilled. The other subtype of this pattern is the achiever who defers nurturing. These women usually attend college and devote the next seven years to their careers. The achieving women often are the first born and identify more with their father than

mother. They excel academically, are fiercely loyal to a company, and often find a mentor in their boss. They remain dependent on this mentor until age 35, when they realize all they have is their job. The next one or two years are usually spent in a moratorium. During this time roughly half these women marry professional men and become stepmothers. All become more outgoing, more responsive to others, and often become a mentor themselves. A subtype of the achiever women are the late-baby superachievers. These women defer nurturing until age 35 or later when they become mothers. They are remarkably and visibly accomplished, such as Margaret Mead (Sheehy, 1974).

The remaining three types of female life patterns represent the minority of women. Integrators try to do it all in their 20's, integrate career, marriage, and motherhood. This type of woman did not begin to appear until the 1950's and 1960's and are absolutely determined not to end up as the hard-nosed career woman stereotype. However these women usually suffer a crisis during their 30's. By this time they are running out of psychic energy and something must go - marriage, career, and/or children - to preserve their sanity. Never-married women represent paranurturers and office wives. Although approximately ten percent of all women are in this group, society has been stingy about acknowledging this as a legitimate pattern. These women are often on the cutting edge surpassing the average single male in education, occupation and

income at every age level. The last type is the transients. During their 20's these women choose to keep all their options open. They follow a pattern of prolonged wandering sexually and occupationally without making any commitments. They have freedom to try various life styles and end up surviving by their wits and talents, which involves a great deal of psychic energy. They often support themselves economically by their involvement in cottage crafts and they often end up as bachelor mothers. These women usually stop their wandering by the age of 30 (Sheehy, 1974).

Sheehy (1974) also found that although women enjoy equal or better physical health than men, they suffer more mental health hazards than men. Married women are far more likely than married men to report feeling that they are about to have a nervous breakdown, experience psychological and physical anxiety, experience feelings of inadequacy in their marriage, and to show phobic reactions, depression, and passivity. Similarly, married women demonstrated poorer mental health than single women.

Maas and Kuyper, from the University of California Institute of Human Development, gathered data from the same people for forty years (1929-1969). In this longitudinal study, interviewers visited elderly people and obtained information about their personality, life style, and what their environment and health conditions were. They then compared these data with data gathered on the same people 40 years

earlier. This study is unique in that it studied a 40 year span during the adult years of these elderly subjects, focusing on the well-to-do rather than the poor elderly. They found that mothers exhibited more changes in their adult life course and life style than the fathers. From this longitudinal study they also described six life-style clusters for mothers. These clusters are: 1) husband-centered wives, 2) uncentered mothers, 3) visiting mothers, 4) work-centered mothers, 5) disabled-disengaging mothers, and 6) group-centered mothers. These clusters differ in the centering focus of their lives. One thing that was consistent for the women in all these clusters was that the women experienced radical changes in their lives as they moved toward and into old age (Prock, 1975).

Some theorists such as Goode (1960) feel that multiple role involvements on the part of women inevitably lead to role overload and conflicts. This results in decreased well being. Others, such as Sieber (1974) and Marks (1977), feel that multiple role involvements yield a net gain in well being. This is a result of both the ego-enhancing knowledge that one can manage several roles, and the additional income (Baruch, Barnett & Rivers, 1980).

For those women with multiple role involvements, aspects of work status, such as occupation and of commitment appear to have a profound effect upon the women's experiences, particularly in the second half of their life span (Barnett & Baruch, 1978). Birnbaum (1975) measured satisfaction and self-

esteem at mid-life in comparable groups of married professionals with children, single professionals and "homemakers". Both groups of professionals were found to be more satisfied and had higher self-esteem than women in the traditional "homemaker" role pattern.

Coleman and Antonucci (1983), using data from a national survey of 2,264 representative American adults, selected 389 women to compare working and non-working women. These researchers found that working women had significantly greater self-esteem ($p < 0.0004$), less psychological anxiety ($p < 0.03$), better physical health ($p < 0.0004$), greater satisfaction with marriage ($p < 0.006$), greater feeling of happiness ($p < 0.09$), and greater satisfaction with life ($p < 0.06$). No significant differences were found on measures of depression, parental satisfaction, immobilization, and interest in life. These same researchers, using a multiple regression test found that anxiety scores were due to employment, marital, and income status, while physical health was predicted by employment, family life cycle stage, and income. Coleman and Antonucci concluded that working women were happier and healthier because their employment status significantly increased their self-esteem.

Today's women, in technologically developed countries, outlive men and their culturally assigned functions, specifically having and raising children. After the age of 45 women are no longer needed as bearers of children, sex objects

or pampered housewives. Instead the middle aged women are often seen as irrelevant in our society (Prock, 1975). Changes that occur in middle aged women include: a change in body image and function. They become grandmothers rather than mothers, feel older, and their social networks, interests, and values may change. After menopause there are numerous physical changes including vasomotor instability, atrophic vaginitis, osteoporosis, coronary atherosclerosis and skin and muscle changes. According to Galloway (1975), females have more emotional instability, nervousness, anxiety, insomnia, fatigue and depression due to the changing hormone levels. Socioculturally women begin to feel a loss of femininity, and as children leave home must adjust to living alone with their husband again (Galloway, 1975). With these changes there is a definite feeling that time is truly running out. They feel imperiled by widowhood and begin to rehearse for living alone (Jacobson, 1982).

Baruch and Barnett (1979) interviewed 2,239 Caucasian women between the ages of 35 and 55. They reported that as these women entered middle age, they had a marked increase in their self-esteem. As these women matured, they discovered a strong sense of self-worth that they did not experience during their younger years. Many of these middle aged women spent their early years caring for husband and children and had no great dreams for their personal achievements. These authors very carefully point out that women's lives are very different

from the lives of men. They also point out that the traditional view that the pillar of a woman's happiness is marriage is not true, nor is well-being dependent upon having children. Instead different life styles suit different women and the right combination of roles creates a high sense of well-being.

These findings, primarily from the work of Baruch and Barnett, contradict earlier work by the two major theorists in adult development, Erikson and Levinson. Erikson and Levinson focus on chronological age and for women focused on their reproductive role and ignored their work role. It was this work role and the women's multiple role involvement that subsequently have been shown to be so crucial to their self-esteem and feeling of well-being.

Motherhood

Although motherhood has been shown not to be a critical factor in a woman's life, it is a major event to a majority of women. Indeed, it has traditionally been felt that child-rearing is the woman's natural job. This child-rearing includes the nurturing, as well as the disciplining, training, breeding, tutelage and attention to the physical needs of the child. This role of mother has, until very recently, also been coupled to that of a submissive, proper wife, with every failing of the child being traced back to the mother (Kiernan &

Scoloveno, 1977).

It is without question that the woman faces difficulties in adjusting to mothering tasks. She must first identify the new child, determine her relationship to the child and guide and reconstruct the family constellation to include a new member. She must also assume responsibility for the care of the baby, learn how to anticipate and recognize the infant's needs and regulate all the demands of the baby (Perdue, Horowitz & Herz, 1977). In studies conducted by Barnett & Baruch (1984), interviewing 160 mothers and fathers, the mothers reported very high levels of responsibility for child-care tasks while the fathers reported low levels of responsibility. These findings held true for employed and unemployed mothers. Sixty-five percent of all solo child-care responsibilities were performed by the mother.

According to Wuerger (1976), parenthood is not a static role. One grows into the role and often experiences conflicts regarding self-identity, authority, marriage and/or career. New parents must face the necessary changes in life style and must recognize the infant is a separate person and not merely an extension of themselves. As the transition into parenthood is occurring, the soon-to-be parent is experiencing great emotional upheavals, is under increasing pressure for readjusting their life style and is in a state of great potential for learning and growth. Hrobsky (1977) identifies four phases in the transition to parenthood. The anticipatory

phase terminates with the birth of the first child. During this time there is an extensive revision of roles and redefinition of rules. It is an intense and safe time to experiment with and test life style and skills in preparation for accepting and integrating a new family member. The honeymoon phase begins after the birth of the infant. It too is an intense period during which an attachment between the parent and child is established. The plateau phase follows during which the parental roles are fully exercised. Finally, the disengagement phase occurs when all children have grown and the parent role is terminated. It should be remembered that for all phases there must be a balancing between the individual, the parent-child, and the couple's needs.

Throughout the woman's life cycle her role is in a continuing dynamic state of flux. As a result the woman, as she moves along her life line and chooses various paths, must formulate and reformulate her goals and structure and restructure her self-image and life style.

Conclusion - Adult Development

Adult development as a field of inquiry is just beginning to come into its own. Although the different theorists use different terminology, their breakdown into stages is remarkably similar. Of these theorists Erikson concentrated on the childhood phases, dealing only superficially with the adult

phases. Levinson dealt only with men and Gould dealt mostly with psychiatric patients. The stereotypes of women roles are just beginning to be broken down. Although work is being done to further clarify this field a great deal remains to be done, especially in the realm of women's roles and development.

Rhythmicity, and Adult Development

Research has shown that in the first weeks of life, the only clear circadian rhythm is the periodicity of electric skin resistance (Luce, 1971). The rate of urine flow is established by the third week of life. By the fifth to ninth month of life, rhythmicity of blood sugar levels, constituents of urine and body temperature appear. The fact that the full term infant displays a 40 to 50 minute sleep cycle is clearly evident (Murray & Zentner, 1979). As the person ages and passes through middle age, there is a slow but steady decline of efficient body functioning. Internal time is at least partially influenced by these declining neural and metabolic processes. These changes in metabolism, and altered circulation of electrolytes, oxygen, creatinine and urea nitrogen all influence the person's energy level, activity capacity and internal biological rhythms (Murray & Zentner, 1979).

The sleep patterns and needs of the elderly are much more variable than those of younger persons. The older person

requires significantly longer to go to sleep than do younger persons. They also awake during the night and rise early in the morning (Colling, 1983; Miles & Dement, 1980). Yet older persons do not require either more or less sleep than younger people. The total amount of sleep required remains the same throughout the adult period, but the pattern changes through the years. Even the type of sleep differs with age. The percentage of time spent in stage IV sleep decreases, allowing for the more frequent wakening. Although some of these changes may be due to cerebral arteriosclerosis, all the reasons for these changes have not been established (Colling, 1983; Hayter, 1980; Murray & Zentner, 1979).

Once the fetus leaves the chemical exchange and internal rhythms of the mother's womb, he is exposed to care within the training system of the external world. From conception to birth and through the entire life span, the person continues to develop. During each passage from one developmental stage to the next, the person undergoes subtle changes in four areas of perception: 1) the interior sense of self in relation to others, 2) proportion of safeness to danger we feel in our lives, 3) perception of time and, 4) a shift at the gut level in our sense of aliveness or stagnation (Sheehy, 1974). It is this interior sense of self and perception of time, specifically the individual's internal time, that is the focus of this study. Neugarten and Datan (1974) report that in middle age life is restructured around time-to-live rather than

time-since-birth. Does this awareness that time is finite push the individual to rise earlier to accomplish more goals? Or it may be a much more basic issue, that with all the tasks and responsibilities that adults must fulfill they simply must alter their time orientation.

The inner realm of the individual is where the cues arise that signal the necessity to change and move on to the next developmental stage. Development optimally permit the person to adapt to his environment by either controlling the environment or controlling his responses to the environment. These developmental processes involve the interplay of physiological characteristics, environmental forces, and psychological mechanisms. Do changing time rhythms, and preferences assist the person to respond to the environment in a more advantageous manner?

Women and mothers often experience extreme life style changes which are accompanied by considerable disconnectedness, and discontinuities in marital, parental, occupational, and other contexts. Women are forced to adapt to these changing conditions (Prock, 1975). Erikson (1963) wrote that:

> Babies control and bring up their families as much as they are controlled by them; in fact, we may say that the family brings up a baby by being brought up by him. Whatever reaction patterns are given biologically and whatever schedule is predetermined developmentally must be considered to be a series of potentialities for changing

patterns of mutual regulation. (p. 69).

Does a person's time preference change over time? It seems most likely that some, but not all, biological rhythms do change across the life span. As previously stated Lehrer (1979) reached this conclusion based on work with blinded girls and their subsequent earlier menarche than sighted girls. Similarly Colling (1983) has reported changes in sleep patterns in the elderly. Conversely, Krieger (1978) has shown no changes in 17-hydroxycorticosteriod rhythms in the elderly.

Since the biological clock is located, at least partially, in the SCN of the hypothalamus, is this also the site of the individual's time preference? The hypothalamus has numerous neural connections to the cerebral cortex, as well as other areas of the central nervous system. It might be speculated that the higher cortical processes, involved with the transition from one developmental stage to the next, will interact with the biological processes occurring in the hypothalamus. Biological rhythmicity and time preference might then be altered. In turn these rhythms and time preferences might provide signals for passages from one developmental stage to the next and allow the individual to adapt to his changing world, life tasks and demands. Individuals are in constant interaction with their environment, an environment filled with ever changing life demands and tasks. Biological rhythms evolved to assist man to better deal with his physical environment (Moore-Ede, Sulzman & Fuller, 1982). Similarly,

developmental stages reflect how the individual perceives and deals with current life demands. The coordinated interaction of these two variables, rhythms and development, would theoretically provide the most effective and efficient mechanism for man to interact and deal with his environment. See Figure 1

No study that connects biological rhythms and adult development has previously been conducted. This study's focus was to build upon previously developed theories and examine connections between two of these theories. To do this a women's time preference, a reported biological rhythm, was examined at different points in her life.

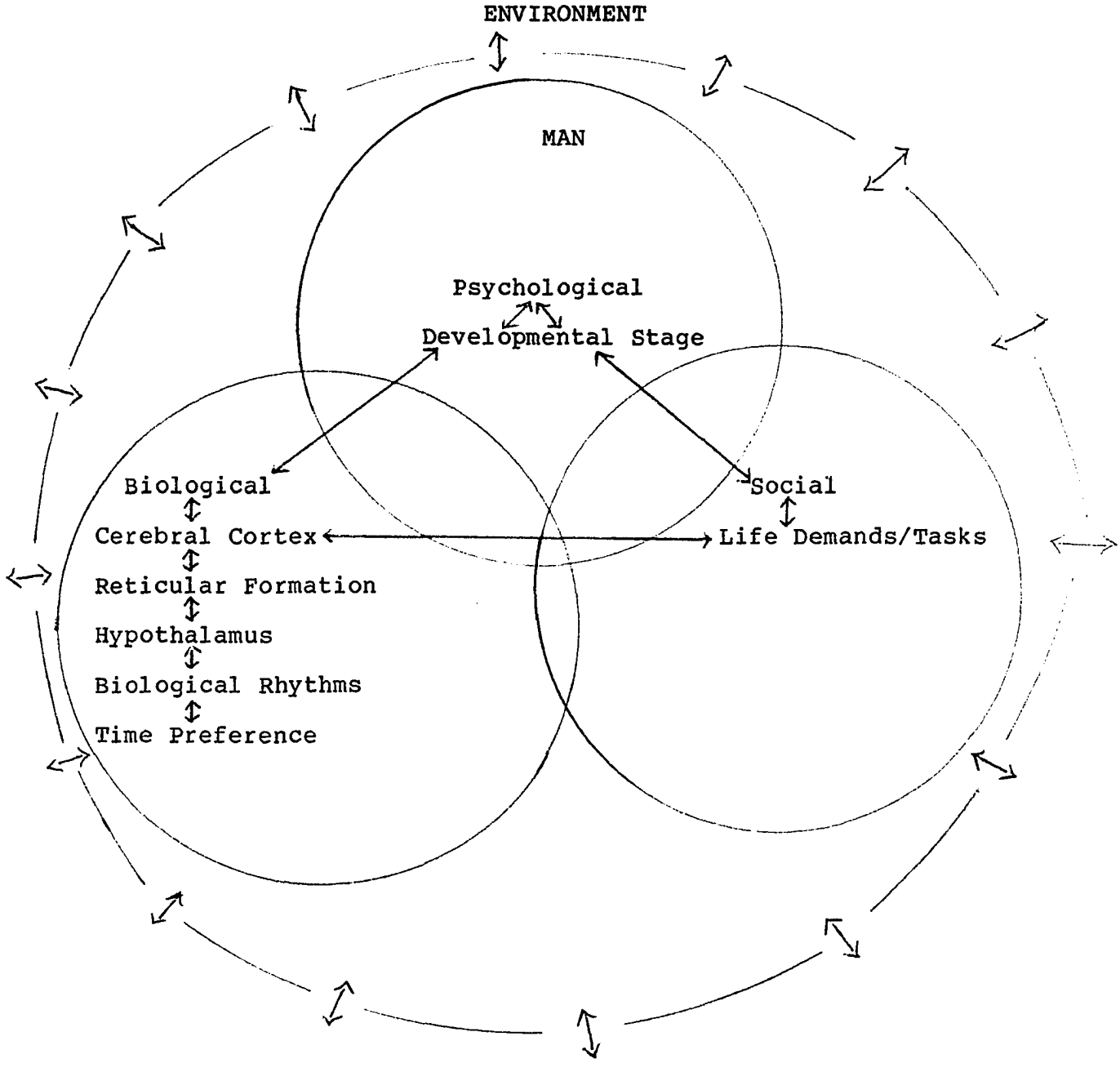
Statement of the Problem

The problem statement studied is as follows:

> Is time preference in middle to late adult women who have experienced the demands of motherhood fixed as an apparent circadian rhythm or adjustable, meeting environmental and social demands?

Figure 1

Model of the Interaction of Inherent Circadian Rhythms and Adult Development



Hypotheses

Hol: Scores on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms will be higher (more morning) at the time of rearing children than either before rearing children or after rearing children (current time).

It has been demonstrated, that in healthy individuals, rhythms show a well defined relation to each other by allowing the organism to anticipate the future (Bassler, 1978; Moore-Ede, et al., 1983). Research has shown that physiologic rhythms are amazingly stable and persistent (Krieger, 1978; Moore-Ede et al., 1983; Williams, 1981). Yet some researchers in the field of adult development have reported that individuals have different time perspectives at different stages of the adult life span (Levinson, 1978; Sheehy, 1981). As Horne (1986) wrote "... about whether an individual's preference for morningness or eveningness is an inherent rhythm or is simply dependent on their life style, I am afraid this is a question which is still a matter for speculation".

Ho2: People who are evening types as young adults will have greater changes in time preference, as measured by A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms, than those who were morning types as young adults.

Numerous researchers report that morning and evening type individuals differ in how easily they each adapt to changes in

their sleep-wake patterns (Akerstedt & Froberg, 1976; Foulkard et al., 1979; Horne, 1986). Floyd (1984) concluded that evening people adjust easier and to much greater changes to shifts in sleep cycles, while Horne (1986) reports evening types adapt to shift work much easier. Based on these earlier findings it was believed that evening types will demonstrate greater changes across the life span than morning types.

Chapter 2

DESIGN OF THE STUDY

This study employed a retrospective design to study time preference, circadian rhythm, and life demands.

Definition of Variables

1. Time Preference: This is defined as an invariable change consisting of a predictable order of fluctuations that causes a person to feel best, and be most active and mentally alert at a certain time of day (Horne, Brass & Pettitt, 1980; Ostberg, 1973). Operationally, time preference is the individual's feeling best time or morningness-eveningness orientation. This was measured by A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms (Horne & Ostberg, 1976).

-Morning types: These are adults who have a preference for early morning to noon hours. They have earlier waking times, a higher waking body temperature, are more alert and active in the morning hours, and retire early (Horne, Brass & Pettitt, 1980; Ostberg, 1973). Operationally, morning types were those 50 subjects who scored highest, the top 25%, (see page 77) on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms (Horne & Ostberg, 1978).

-Neither types: These people are those who cannot be clearly defined as morning or evening types by rising or retiring

times, most alert and active time of day, or pattern of body temperature changes (Horne, Brass & Pettitt, 1980; Ostberg, 1973). Operationally defined, neither types were those 100 subjects who scored the middle 50% (see page 77) on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms (Horne & Ostberg, 1978).

-Evening types: These are adults who have a preference for late afternoon to evening hours. They have later waking times, a lower waking body temperature and are more alert and active in the late afternoon and/or evening (Horne, Brass & Pettitt, 1980; Ostberg, 1973). Operationally, evening types were those 50 subjects who scored the lowest, or bottom 25%, (see page 77) on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms (Horne & Ostberg, 1978).

2. Circadian Rhythm: This is defined as a continual change consisting of a predictable order of fluctuations that causes humans to be different at different times of the day. This pattern of fluctuations occurs once every 20 to 28 hours (Farr et al., 1984; Pauly, 1983; Restak, 1984). Inherent circadian rhythms are marked by their stability and ability to persist throughout the life span of the organism (Krieger, 1978; Luce, 1971; Moore-Ede et al.,1983; Williams, 1981). Circadian rhythms were measured by A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms (Horne & Ostberg, 1976).

3. Life Demands: These are defined as tasks and/or

responsibilities that are an integral part of the individual's role function. These demands must be attended to. The individual's specific life demands vary according to his or her life situation and stage of development. Life demands were operationally defined as the woman's completion of school, child-rearing, and the release from all child-rearing responsibilities. Completion of school is further defined as the completion of full time school enrollment, either at the high school, college, or graduate level.

Assumption

1. Subjects took the task of participating in this study seriously enough to give honest, valid responses.

Limitations

1. Results of this study are limited to women who were born in the United States between 1927 and 1947.
2. Results are also limited to women who have been, or are currently married and have borne and raised at least one child.
3. A question exists as to cultural influence on a person's time preference. Subjects for this study were drawn from the northeastern United States. Generalization of results to other countries, and even to other regions in the United States should be done cautiously.

The Method of Study

Sampling

Two hundred and twenty-two females were recruited from women's groups, specifically hospital auxillaries, church groups, and bridge, tennis, and other social groups in the northeastern United States. Twenty-two subjects were deleted, yielding the final sample size of 200. Nineteen of the deleted subjects were eliminated due to age (younger than 40 or older than 60 years), not having borne a child, or still having children at home. The three other subjects were dropped from the final sample when they reported that they could not accurately recall earlier times in their lives. All subjects were born in the United States, and were literate in english. No subject had any known psychiatric disease or memory disorder. All subjects had at least a six month period between finishing school and having her first child, and at least six months between when she was free of all child rearing responsibilities and participating in the study.

Data Collection Procedure

Subjects were interviewed for no more than one hour in groups of 1 to 20 people. Each subject completed a one page questionnaire asking demographic data. (See Appendix A.) Each subject also completed A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms

three separate times. One time the questionnaire was completed as they felt at the present time. Each subject was talked back, by using major events in history and in their personal lives to create reminiscence, to a time when they had finished school yet did not have children or child rearing responsibilities. When each subject was in the proper time, as judged by their telling of anecdotes, nodding of heads, and relaxed smiling appearance, they completed the questionnaire for that time in their lives. Similarly each group was talked backed to when they had primary child rearing responsibilities for pre-school children. Again each subject completed the same questionnaire. For each group of subjects the order of questionnaire administration was randomized.

It was unexpectedly easy for the subjects to recall earlier times in their lives. After only one or two such as "Where were you living when you finished school?", "Before you had any children what did you do for fun?", or "What was your child's first word?", one subject would start telling an anecdote and then the others would quickly follow. More often than not, the subjects' story telling had to be cut short and the subjects refocused onto the questionnaire. Only 3 of 222 women who participated could not successfully remember earlier times in their lives. As stated earlier, these three women were not included in the final sample.

By asking subjects to recall and narrate experiences, and feelings from the past, this study employed a self-report tool

in a retrospective methodology. In using a retrospective method the subjects are allowed to remain in their natural setting, thereby providing a greater connection to the real world, and providing more representative findings of the broader target population. In using self-reports, it is assumed that a subject's understanding of the standard of measurement will not change from one testing to the next, avoiding response shifts. Studies which yield retrospective self-report data provide a more sensitive assessment of a subject's perspective of personal change than cross-sectional studies (Abdellah & Levine, 1965; Howard, 1980). It is believed that the avoidance of response shifts, and the more sensitive assessment of personal change out weighed the potential attenuation in memory.

A proposal of this study was submitted and approved by Adelphi University's Human Subject Review Committee prior to the collection of data. Before subjects filled out the questionnaire they were told that this was a project studying a person's time preference through the adult life cycle. Assurances were given that all data would be treated as confidential and as an aggregate. Subjects were told that participation was totally voluntary. Completion of the questionnaires was taken as voluntary consent. A confidential list of subject names was maintained in a locked file until completion of the study, when it was destroyed. This list was maintained to assure independence of sampling.

Instrumentation

Self-Assessment Questionnaire To Determine Morningness-Eveningness In Circadian Rhythms

This 19 item questionnaire was modified from an earlier Swedish language questionnaire. It is designed to differentiate those individuals with a morning, evening, or indeterminate rhythm preference. According to Horne, Brass, and Pettitt (1980) 45% of adults may be classified as either moderate to extreme morning type, or moderate to extreme evening type. Fourteen items are designed to be forced choice. The remaining five items have time scales. Three of these are marked off in fifteen minute periods over a seven hour span. The remaining two questions contain 24 hour spans, marked off in one hour periods. Questions are presented in a logical sequence, with the order of choices balanced to avoid a fixed response pattern (Horne & Ostberg, 1976). (See Appendix B.)

Each question is scored. These scores are summed to provide a total score. Published total scores between 70 and 86 indicate definitely morning type, 59 and 69 moderately morning type, 42 and 58 neither type, 31 and 41 moderately evening type, and 16 and 30 definitely evening type (Horne & Ostberg, 1976). These scores were established using a British sample. The cut-off points were based on a normal distribution of scores. The middle 45% of scores were set as neither types. The higher range was divided into moderately morning (20%) and definitely morning (7.5%). The lower range was similarly

divided into moderately evening (20%) and definitely evening (7.5%) (Horne, 1986). Horne (1986) also reports that he found that these cut-off values varied somewhat between cultures. He reports that the French version of the questionnaire uses quite different cut-off points than the English version. Cut-off values specifically for an American sample are not available. Horne (1986) suggested modifying the published values. Therefore the validity of the questionnaire's published cut-off values must be seriously questioned. It is specifically for this reason that published scoring values were not used in this study. Rather the same criteria used by Horne (1986) and Horne and Ostberg (1976), in conducting studies with northern European subjects, was employed in this study with American subjects. On the pre-children sampling, the 100 subjects who scored in the middle 50% were considered "neither" types. The 50 subjects (25%) who scored the highest on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms at the pre-children sampling were considered "morning" types. The final 50 subjects (25%) who scored the lowest, at the prechildren sampling on the self-assessment questionnaire were considered "evening" types.

Horne and Ostberg (1976) in developing this questionnaire administered an earlier 21 question version to 150 adults, aged 18 to 32 years, with males equaling females. Results were item analyzed and three questions were deleted as not being discriminating. This resulted in the questionnaire used.

Concurrent validation was demonstrated by using the criterion of circadian variation of oral body temperature. Forty-eight of the 150 subjects previously mentioned measured and recorded their temperature every 30 minutes while awake. These authors reported marked differences in body temperature, and waking and sleeping times between the three groups (morning, neither, and evening types). When the questionnaire's classifications were used, significant correlations were found between peak body temperature and sleeping time ($r = +0.37$), peak body temperature and waking time ($r = +0.42$), peak body temperature and questionnaire classification ($r = -0.51$), sleep and waking times ($r = +0.65$), sleep time and questionnaire classification ($r = -0.67$), and waking time and questionnaire classification ($r = -0.79$). There was no correlation with duration of sleep. Using a 2-tailed t-test, significant results were found between peak body temperature and sleep time ($p = 0.05$), peak body temperature and waking time ($p = 0.001$), peak body temperature and questionnaire classification ($p = 0.01$), sleep and waking times ($p = 0.001$), bed time and questionnaire classification ($p = 0.001$), and waking time and questionnaire classification ($p = 0.001$). Horne and Ostberg (1976) concluded that validity was supported based on these significant correlations and t-tests.

No published data on the tool's reliability could be found. The tool has been widely used in studies and is used by the Sleep-Wake Disorder Center at Montefiore Medical Center (Horne & Ostberg, 1976, 1977; Horne, Brass & Pettitt, 1980;

Horne, personal communication, August 12, 1985; Thorpy, personal communication, August 18, 1985).

To establish reliability, a test-retest correlation was performed. A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms was administered to 21 patients within 24 hours of admission to a coronary care unit. Twelve of these patients returned a second questionnaire, which was completed after their discharge, and 3 weeks after the first questionnaire was completed. These 12 people became the subjects for the reliability study. Of these 12 subjects, 10 were males, and 2 were females. Eleven were married. Five were Protestant, 5 Catholic, and 2 did not state their religious preference. Their mean age was 61.5 years, with a S.D. ++ 8.523, and their median age was 61 years. The correlation between the initial test and the retest 3 weeks later ($r = + .908$) indicated an acceptable reliability.

Statistical Procedures

The first hypothesis, that an individual's time preference is dependent upon life demands, was analyzed using an analysis of variance with repeated measures ($p < .05$). This technique was selected since it minimizes experimental error by controlling for the differences between subjects. It was specifically hypothesized that scores on A Self-Assessment Questionnaire to Determine Morningness-Eveningness In Human

Circadian Rhythms would be significantly higher (more morning) at the time of rearing children than either before rearing children or for the current, post-rearing time. The higher scores, or a greater morning orientation, would be due to the concomitant stage of adult development and its inherent life demands. See Figure 2.

The second hypothesis, that evening type individuals will show greater variability in questionnaire scores over time than morning type individuals was analyzed by using a 2 X 3 analysis of variance with repeated measures ($p < .05$). It was hypothesized that evening type individuals would show significantly greater variability (with low scores before having children and at the current time and high scores while rearing children) than morning types, who will demonstrate very little variability and consistently high scores. See Figure 3.

Figure 2

Analysis Of Variance With

Repeated Measures Of Questionnaire Scores

Subjects	Pre-children	Children	Current	
1				
2				
3				$p < .05$
etc.				

Figure 3

Analysis Of Variance With

2 X 3 Repeated Measures Of Questionnaire Scores

Subjects	Pre-children	Children	Current
Evenings			
Mornings			

$p < .05$

Chapter 3

RESULTS

Sample Description

Of the 200 women in the final sample, ages ranged from 41 to 60 years. The mean age was 52.6950 years (S.D. + 5.5449), with a median of 53.0000 years, and a mode of 60 years. The age characteristics of the evening (n = 50),neither (n = 100), and morning sub-samples (n = 50) are shown in Table 1. As can be seen, the evening sub-sample is younger by 5.600 years than the oldest sub-sample, that of the morning types. The evening types, as well as being the youngest, also showed the greatest variance in age. The morning types had the least amount of variance in their ages, with the neither type subjects falling in between.

Table 1

Age of Subjects in Years

	Evening Types	Neither Types	Morning Types	Total Sample
Range	41 - 60	41 - 60	43 - 60	41 - 60
Mean	49.8200	52.7600	55.4200	52.6950
Variance	29.6199	28.4871	21.6771	30.7454
St. Dev.	5.4424	5.3373	4.6559	5.5449
Median	49.0000	53.0000	56.5000	53.0000
Mode	46,48,49	60	60	60

The subjects finished full time schooling between the ages of 16 and 47 years. The mean age for finishing school was

20.0850 years (S.D. + 3.9909), with a median of 20.0000 years and a mode of 21 years. The characteristics of age when full time schooling was finished for each sub-sample are listed in Table 2. As with age, the morning sample is the most homogeneous, with the smallest range, variance and standard deviation. All three of the sub-samples had one or two subjects on the extreme right. This was most marked in the neither sub-sample in which there were three subjects who reported their ages to be 40, 44, and 47. Each subject acknowledged at least a six month period between finishing school and having their first child. Therefore it must be assumed that for the subjects outlying on the extreme right that the reported age of finishing school represented education that was pursued after having completed some school, had children, and then returned to school for further education.

Table 2

Age When Subject Had Finished School

	Evening Types	Neither Types	Morning Types	Total Sample
Range	16 - 34	16 - 47	16 - 29	16 - 47
Mean	20.3400	20.3900	19.2200	20.0850
Variance	10.5555	23.0079	6.6241	15.9274
St. Dev.	3.2489	4.7967	2.5737	3.9909
Median	20.0000	20.0000	18.0000	20.0000
Mode	21	21	18	21

The women in this sample had their first children while they were between the ages of 17 and 38 years. The average age

for having this first child was 23.7300 years. The median age was 23.0000 years, while the mode was 22 years. As can be seen in Table 3 all of the sub-samples are very comparable. Each sub-sample had one of two subjects at the extreme right. These subjects were those who went right from high school, to college, to graduate school before starting a family.

Table 3

Age When Subjects Had First Children

	Evening Types	Neither Types	Morning Types	Total Sample
Range	17 - 35	18 - 38	18 -35	17 - 38
Mean	22.8600	23.8600	24.2300	23.7300
Variance	15.1024	14.3236	16.5000	15.3739
St. Dev.	3.8862	3.7847	4.0620	3.9210
Median	22.0000	23.0000	23.5000	23.0000
Mode	19	23	22,25	22

The age of the sample when last children had left home, ranged from 38 to 60 years. The average age was 49.2100 years (S.D. + 5.0441). The median age was 49.0000 years and the mode was 45 years. As can be seen in Table 4, the sub-samples were similar. The morning sample is the most homogeneous, with no extreme values. It was also slightly older. Although the morning group was also sightly older when they had their first children, there was a greater difference in their age when they were free of child rearing responsibilities.

Table 4

Age of Subjects When Free of Child-Rearing Responsibilities

	Evening Types	Neither Types	Morning Types	Total Sample
Range	40 - 59	38 - 60	42 - 59	38 - 60
Mean	47.1400	49.4500	50.8400	49.2100
Variance	21.6330	27.1186	20.0146	25.4429
St. Dev.	4.6511	5.2076	4.4738	5.0441
Median	46.0000	49.0000	50.0000	49.0000
Mode	45	45	50	45

For the total sample, 160 (80%) were currently married, 15 (7.5%) divorced, 23 (11.5%) widowed, and 2 (1%) separated. All subjects had been married at some point in their lives. The evening sub-sample had the greatest number of currently married subjects (88% vs 78% or 76%). This is most likely due to this sub-sample being the youngest and having the fewest number of widowed subject (4% vs. 13% or 16%). See Table 5 for a marital status description of each sub-sample.

For those subjects who reported their number of years married, values ranged from 5 to 42 years. The average was 28.7202 years (S.D. + 7.0308), the median was 30.0000, and the mode was 30 years. The evening sub-sample had the fewest years of marriage as indicated by the mean, median, and mode. This was a consistent finding with the evening sub-sample being the youngest group. However the evening subgroup also has the smallest range. This is most attributable to the differences in widowhood, but the differences cannot be specifically

identified.

Table 5

Marital Status

	Evening Types	Neither Types	Morning Types	Total Sample
Married	44 (88%)	78 (78%)	38 (76%)	160 (80%)
Divorced (7.5%)	3 (6%)	9 (9%)	3 (6%)	15
Widowed (11.5%)	2 (4%)	13 (13%)	8 (16%)	23
Separated	1 (2%)	0 (0%)	1 (2%)	2 (1%)

Table 6

Years Married

	Evening Types	Neither Types	Morning Types	Total Sample
Range	14 - 38	6 - 41	5 - 42	5 - 42
Mean	27.7083	28.2083	30.7143	28.7202
Variance	33.5301	54.6295	51.1665	49.4315
St. Dev.	5.7905	7.3912	7.1531	7.0308
Median	27.5000	28.5000	32.0000	30.0000
Mode	24	25	32	30

Subjects had between 1 and 11 children, the mean being 3.1900 (S.D. + 1.5051). The evening subjects had between one and six children, the mean being three (S.D. + 1.2454). The neither sub-sample had between 1 and 11 children, with a mean of 3.2500 (S.D. + 1.6476). The morning sub-sample's mean was 3.2600 children (S.D. + 1.4542), with a range of one to nine children. For the total sample, as well as for the neither and

morning sub-samples, there was one subject who skewed the sample to the right. Thirty-four percent of the evening and neither sub-sample subjects had two children each, while 32% of the morning subjects had three children and 32% of the total sample had two children. See Table 7.

Table 7

Number of Children

	Evening Types	Neither Types	Morning Types	Total Sample
Range	1 - 6	1 - 11	1 - 9	1 - 11
Mean	3.0000	3.2500	3.2600	3.1900
Variance	1.5510	2.7146	2.1147	2.2652
St. Dev.	1.2454	1.6476	1.4542	1.5051
Median	3.0000	3.2500	3.2600	3.1900
Mode	2	2	3	2

The percentage of subjects at various educational levels is shown in Table 8. Because of the voluntary nature of participation, and the location of recruiting the subjects, this sample is not representative of the population as a whole in terms of education. These subjects had the freedom, time, and economic status to belong to bridge, tennis, and social groups or volunteer in hospitals or churches.

If the categories of education completed is further collapsed, the evening sub-sample is the most educated. The evening sub-sample had 44.8% of its subjects educated at the baccalaureate level or higher. Thirty-four percent of neither subjects, and 28.6% of morning subjects were equally well-

educated. This finding is most probably due to a sampling aberration.

Table 8

Highest Grade Completed

	Evening Types	Neither Types	Morning Types	Total Sample
Below High School	1 (2.0%)	3 (3.0%)	2 (4.1%)	6 (3.0%)
High School	10 (20.4%)	24 (24.0%)	19 (38.8%)	53 (26.8%)
Diploma RN	4 (8.2%)	18 (18.0%)	5 (10.2%)	27 (13.6%)
Technical School	0 (0.0%)	0 (0.0%)	3 (6.1%)	3 (1.5%)
Business School	2 (4.1%)	2 (2.0%)	1 (2.0%)	5 (2.5%)
Some College	8 (16.3%)	11 (11.0%)	5 (10.2%)	24 (12.1%)
Associate Degree	2 (4.1%)	8 (8.0%)	0 (0.0%)	10 (5.1%)
College	13 (26.5%)	21 (21.0%)	9 (18.4%)	43 (21.7%)
Graduate School	8 (16.3%)	11 (11.0%)	3 (6.1%)	22 (11.1%)
Ph.D.	1 (2.0%)	2 (2.0%)	2 (4.1%)	5 (2.5%)
Missing Subjects	1	0	1	2

Table 9 describes the samples' professional/occupational status. In this demographic variable, the sub-samples are quite similar. When the subjects are regrouped into working and nonworking subjects, both evening and morning samples had 22% non-workers, while neither types had only 14.3% non-working subjects. If these data were again regrouped into professional/management vs. technical/blue collar/sales, the

evening and neither samples were similar, with 48% and 49% of their subjects respectfully falling into the professional/management category, while the morning sub-sample had only 38% in the professional/management category.

Table 9

Professional - Occupational Status

	Evening Types	Neither Types	Morning Types	Total Sample
Professional	19 (38.0%)	42 (42.9%)	16 (32.0%)	77 (38.9%)
Supervisory/ Management	5 (10.0%)	6 (6.1%)	3 (6.0%)	14 (7.1%)
Clerical/ Technical	10 (20.0%)	27 (27.6%)	17 (34.0%)	54 (27.3%)
Sales	1 (3.0%)	4 (4.1%)	0 (0.0%)	5 (2.5%)
Blue Collar	4 (8.0%)	5 (5.1%)	3 (6.0%)	12 (6.1%)
Retired	1 (2.0%)	4 (4.1%)	2 (4.0%)	9 (4.5%)
Housewife	10 (20.0%)	8 (8.2%)	9 (18.0%)	27 (13.6%)
Missing	0	2	0	2

For all the subjects in the study, their average waking time was 6:13 AM (S.D. +0.9772), ranging between 3:30 AM and 10:00 AM. As can be expected from their labels, the evening sub-sample awoke the latest and the morning sub-sample the earliest. However there was less than one hour separating the average waking times of these two groups. The evening sub-sample had the greatest variance in their waking times. (See Table 10.) These findings are probably due to the fact that for most of the subjects, 57.6%, their waking time was required, and not their choice. The evening sub-sample had the

greatest percentage (63.3%) of subjects who reported their waking time was required of them rather than their choice. (See Table 11.)

Table 10

Subjects' Current Waking Time

	Evening Types	Neither Types	Morning Types	Total Sample
Range	4:45 - 9:00 AM	3:30 - 10:00 AM	3:45 - 8:15 AM	3:30 - 10:00 AM
Mean	6:38 AM	6:16 AM	5:44 AM	6:13 AM
Variance	1.0031	0.8258	0.7844	0.9549
St. Dev.	1.0015	0.9087	0.8857	0.9772
Median	6:30 AM	6:00 AM	5:45 AM	6:00 AM
Mode	6:00 AM	6:00 AM	6:00 AM	6:00 AM

Table 11

Subjects' Chosen or Required Waking Times

	Evening Types	Neither Types	Morning Types	Total Sample
Choice	17 (34.7%)	36 (36.4%)	27 (54.0%)	80 (40.4%)
Required	31 (63.3%)	60 (60.6%)	23 (46.0%)	114 (57.6%)
Both	1 (2.0%)	3 (3.0%)	0 (0.0%)	4 (2.0%)
Missing	1	1	0	2

The average waking time of the subjects' husbands was later than that of the subjects by 25 minutes. Contrary to the subjects' waking time, for the husband's waking time the evening sub-sample had the earliest rising time and the morning group the latest. This finding was consistent with comments made by a number of the subjects that their husbands' time

preference was the opposite of theirs and has been all through their marriages. The husbands' waking time demonstrated greater variance than the subjects'. This is especially evident in the neither and morning sub-samples, both of which had one night worker. As with the subjects' waking time, the husbands' waking time was greatly influenced by having their waking time dictated to them. Even though there was almost a half hour difference between the subjects' and husbands' waking time, few subjects reported being disturbed by their husbands' waking time. (See Table 12, Table 13, and Table 14.)

Table 12

Husbands' Current Waking Time

	Evening Types	Neither Types	Morning Types	Total Sample
Range	4:45 AM - 9:00 AM	4:00 AM - 6:00 PM	4:00 AM - 3:00 PM	4:00 AM - 6:00 PM
Mean	6:27 AM	6:42 AM	6:46 AM	6:38 AM
Variance	0.8114	3.1086	4.5206	2.7756
St. Dev.	0.9008	1.7631	2.1262	1.6660
Median	6:30 AM	6:30 AM	6:00 AM	6:30 AM
Mode	6:00 AM 6:30 AM	6:00 AM	6:00 AM	6:00 AM

Table 13

Husbands' Waking Time Choice Or Required

	Evening Types	Neither Types	Morning Types	Total Sample
Choice	16 (35.6%)	26 (34.7%)	17 (45.9%)	59 (37.6%)
Required	29 (64.4%)	49 (65.3%)	20 (54.1%)	98 (62.4%)
Both	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Missing	5	25	13	43

Table 14

Incidence Of Being Disturbed By Husbands' Waking

	Evening Types	Neither Types	Morning Types	Total Sample
Yes	9 (19.6%)	9 (11.7%)	7 (19.4%)	25 (15.7%)
No	37 (80.4%)	68 (88.3%)	29 (80.6%)	134 (84.3%)
Missing	4	23	14	41

The scores on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms that reflected the subjects' time preference at the time in their lives when they had finished full time schooling, but before they had children (prechildren scores), ranged from 18 to 77 points. It was this set of scores that determined how a subject was classified: the lowest 50 scores (25%) became the evening sub-sample, the middle 100 scores (50%) became the neither sub-sample, and the highest 50 scores (25%) became the morning sub-sample. The cut off points for both the evening and morning sub-samples fell on a point that was shared by a number of subjects. Therefore the necessary number of subjects

was chosen randomly to make the two sub-samples. The remaining subjects, even with a similar score were left in the neither sub-sample. The evening sub-sample scores were the most dispersed, with the widest range, and greatest variance. The morning sub-sample scores were the most homogeneous as indicated by the range and variance. The difference in means between the evening and morning sub-samples was 33.7600, the greatest difference between any sub-sample, at any point in time. As would be expected, the neither sub-sample fell between the evening and morning sub-samples on all parameters. See Table 15.

Table 15

Prechildren Questionnaire Scores

	Evening Types	Neither Types	Morning Types	Total Sample
Range	18 - 43	43 - 63	63 - 77	18 - 77
Mean	34.2200	53.2600	67.9800	52.1800
Variance	44.8280	30.4972	12.5098	173.64407
St. Dev.	6.6954	5.5224	3.5369	13.1775
Median	35.5000	53.0000	67.0000	53.0000
Mode	41, 43	60	67	60

The retrospective children-rearing questionnaire scores represented the subjects' scores on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms for the time frame when they had child rearing responsibilities for at least one pre-school child. The mean score for each group had increased from the

prechildren score (evenings = + 12.3800, neithers = + 3.4400, total sample = + 4.6550), except for the morning sub-sample (- 0.6400). The range and variability for all samples had also increased. As with the prechildren scores, the evening sub-sample is the most dispersed, the morning sub-sample the most homogeneous. Although the difference between the evening and morning mean was only 20.7400, the relationship between the three sub-samples' means remained intact, with the evening mean the lowest, the morning mean the highest, and the neither mean falling between the other two. However, there was a great overlap of scores between the three sub-samples. (See Figure 4, page 102.) See Table 16.

Table 16

Children Questionnaire Scores

	Evening Types	Neither Types	Morning Types	Total Sample
Range	30 - 63	39 - 70	54 - 77	30 - 77
Mean	46.6000	56.7000	67.3400	56.8350
Variance	78.6529	43.9897	26.7595	101.8963
St. Dev.	8.8687	6.6325	5.1730	10.0944
Median	46.5000	58.0000	68.0000	58.0000
Mode	39,53,55	58, 59 61, 62	70	58, 59, 61,62,70

The now questionnaire scores represent how the subjects felt currently when they completed A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms. These scores showed the greatest range and

variance, with the evening group having the greatest variance among the sub-samples. These scores represent a small increase (more morningness) over the children scores (evenings = + 1.8200, neithers = + 1.3900, mornings = + 0.4400, total sample = + 1.2650). The evening types demonstrated a gain of 14.2000 points from the prechildren to now scores, the neither types gained 4.8300 points, and the total sample gained 5.9200 points. Only the morning types demonstrated an overall decline in scores, - 0.2000 points. As with the children scores, the three sub-samples maintained their relationship, the evening types having the lowest mean, the morning types with the highest mean (see Figure 4, page 102). However specific scores within the sub-samples are overlapping to an even greater extent. The difference between the evening and morning means is now the narrowest (19.3600). See Table 17. The difference in score means indicate that overall an individual's time preference, as determined by their prechildren questionnaire score, remain consistent throughout their life. However the gap between evening and morning scores have narrowed.

Table 17

Now Questionnaire Scores

	Evening Types	Neither Types	Morning Types	Total Sample
Range	22 - 71	35 - 75	52 - 79	22 - 79
Mean	48.4200	58.0900	67.7800	58.1000
Variance	110.5748	72.8299	28.3791	117.6069
St. Dev.	10.5155	8.5341	5.3272	10.8447
Median	48.5000	59.0000	68.0000	60.0000
Mode	55	59,60,61	65	65

Hypotheses Testing

Ho1: Scores on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms will be higher (more morning) at the time of rearing children than either before rearing children or after rearing children (now time).

This hypothesis was tested using an analysis of variance with repeated measures, and the orthogonal option, BMDP statistical software, program 2V (Dixon, et al., 1983). All results, F levels, are significant, see Table 18. There is a significant difference between the sub-samples, evening, neither, and morning subjects ($F = 242.99$, $p < 0.0001$). There is a significant difference between time, prechildren, children, and now questionnaire scores ($F = 71.95$, $p < 0.0001$). There is also a significant interaction between type (evening,

neither, and morning), and time (prechildren, children, and now), $F = 30.04$, $p < 0.0001$.

The orthogonal results indicate that there is a significant linear component for time ($F = 109.43$, $p < 0.0001$) and a linear interaction of time and type [R(1), $F = 41.75$, $p < 0.0001$]. There is also a significant quadratic function. This is true for time [R(2), $F = 19.19$, $p < 0.0001$], and for the interaction of time and type [R(2)T, $F = 13.56$, $p < 0.0001$].

Table 18

Source Table
Repeated Measures ANOVA

Source	Sum of Squares	df	Mean Squares	F	Tail Prob.
Mean	1669334.40	1	1669334.40	17821.99	0.0000
Type	45520.37	2	22760.18	242.99	0.0000
Error	18452.42	197	93.67		
R(1)	3549.46	1	3549.46	109.43	0.0000
R(1)T	2708.64	2	1354.32	41.75	0.0000
Error	6389.72	197	32.44		
R(2)	442.37	1	442.37	19.19	0.0000
R(2)T	625.29	2	312.65	13.56	0.0000
Error	4540.64	197	23.05		
R	3991.82	2	1995.91	71.95	0.0000
RT	3333.93	4	833.48	30.04	0.0000
Error	10930.36	394	27.74		

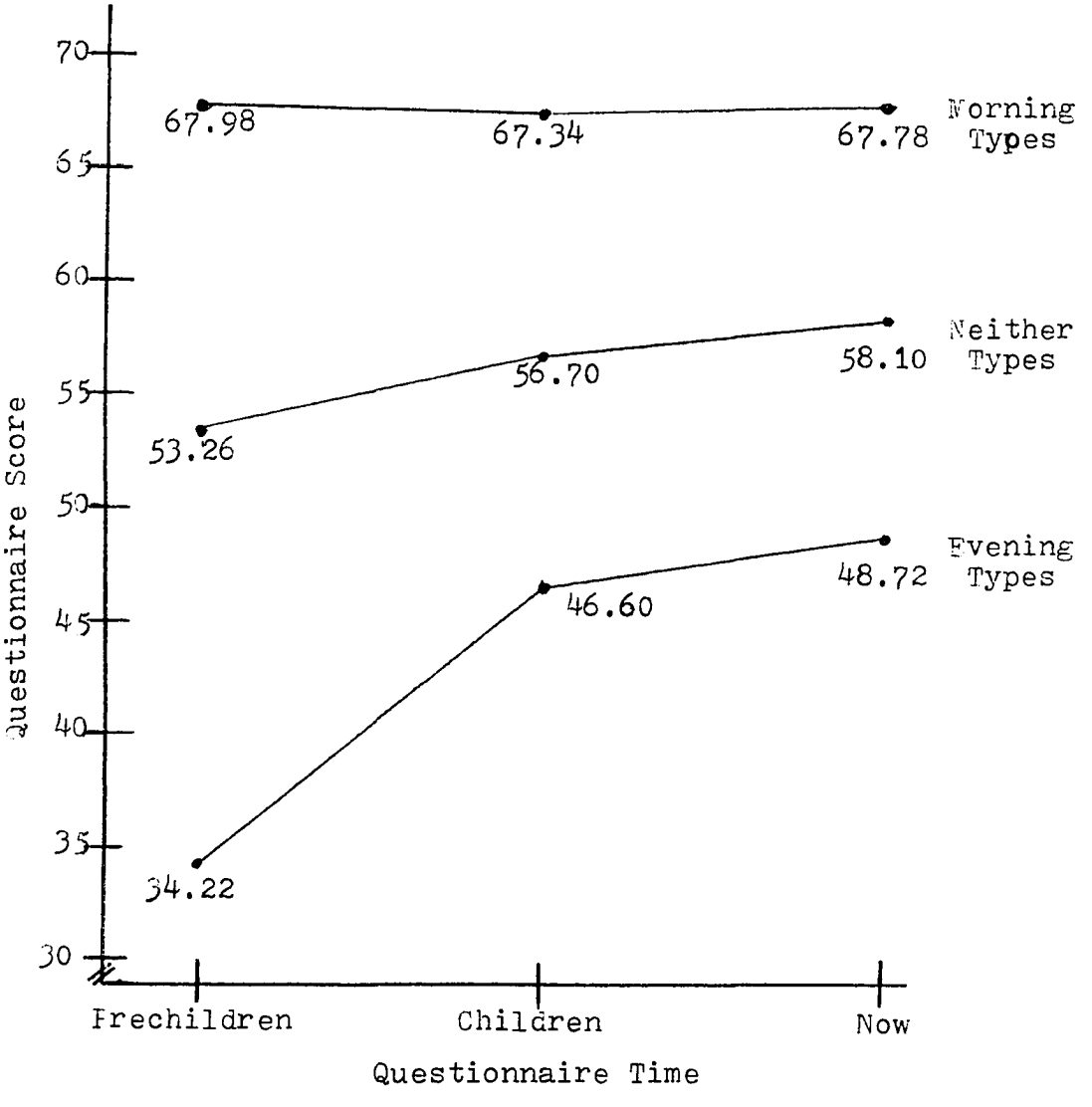
R = time (prechildren, children, now)
T = type (evening, neither, morning)

Based on these findings, the means of the different groups at the different time points were graphed out (see Figure 4). The morning group, the top line, is clearly linear. The middle line, representing the neither group, is questionably linear, although there is a slight change in the slope of the line at

the children time point. The lowest line, that of the evening subjects, is clearly not linear; taking a sharp positive slope from prechildren to children, and then leveling off from children to now. None of the lines demonstrate a clear quadratic function. The evening line is the closest to being quadratic, yet the now questionnaire score does not decline below the children questionnaire score. Therefore, where the quadratic function comes into play is still an open question.

Figure 4

Graph of Questionnaire Score Means



The graph also supports the earlier finding of an interaction between type (evening, neither, and morning), and time (prechildren, children, and now). This is indicated by the three lines not being parallel. Furthermore since none of the lines intersect this is an ordinal interaction, indicating that the rank order of treatment is constant.

Since the interaction is ordinal, an analysis of simple main effects was done. Using the Scheffe procedure, the results are as follows:

At the prechildren questionnaire
- evening and neither types F = 20.8717 *
- evening and morning types F = 30.4332 *
- neither and morning types F = 11.4094 *.

At the children questionnaire
- evening and neither types F = 7.8285 *
- evening and morning types F = 19.6884 *
- neither and morning types F = 8.2470 *.

At the now questionnaire
- evening and neither types F = 7.5029 *
- evening and morning types F = 18.3783 *
- neither and morning types F = 7.5029 *.

Evening types
- prechildren and children F = 11.7523 *
- prechildren and now F = 13.4800 *
- children and now F = 1.7277 (N.S.).

Neither types
- prechildren and children F = 4.6182 **
- prechildren and now F = 6.4977 *
- children and now F = 1.8795 (N.S.).

Morning types
- prechildren and children F = 0.6075 (N.S.)
- prechildren and now F = 0.4177 (N.S.)
- children and now F = 0.4177 (N.S.).

(* significant at $p < 0.01$)
(** significant at $p < 0.05$)

All of the tests for questionnaire times are significant,

therefore indicting that each type, evening, neither, and morning is distinctly different from the other two types at each of the three time measurements. These obtained F values are consistent with what is observed in the graph of the means (Figure 4).

For the tests examining the specific types, only four of the Scheffe procedures are significant. For both evening and neither types, there are significant differences between the prechildren to children, and prechildren to now questionnaires. However there were no significant differences in either of these two groups on the children to now comparison. These findings are consistent with the graphed means (Figure 4). For the morning subjects there are no significant differences at any time point. Again this is consistent with the linear function seen on the graph for the morning type subjects.

Based upon the above findings, the first hypothesis was not completely supported. This hypothesis stated that: Scores on A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms would be higher (more morning) at the time of rearing children than either before rearing children or after rearing children (now time). The data supports the hypothesis that for evening and neither subjects, their scores increased (became more morning) from the prechildren to children time. However for both the evening and neither groups. the scores were not lower at the current (now) time, but rather continued to increase, although not

significantly. For the morning type group this hypothesis was not supported at all. Statistically this group's scores did not change at all across the life span. For the sample as a whole, Scheffe tests on the means (prechildren = 52.1800, children = 56.8350, now = 58.1000) yield the following results:

prechildren and children F = 5.3295 *
prechildren and now F = 6.7778 *
children and now F = 1.4483 (N.S.).
(* significant at $p < 0.01$)

Therefore, for the sample as a whole there is a significant increase in scores, significant change toward morningness, from prechildren to children times, but there was not a decline in scores, change to more eveningness, from children to now, as originally hypothesized.

Ho2: People who are evening types as young adults will have greater changes in time preference, as measured by A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms, than those who were morning types as young adults.

This hypothesis was tested using an analysis of variance with repeated measures, and the orthogonal option. Only subjects determined to be evening or morning types by their prechildren questionnaire scores were included in this analysis ($n = 100$). There is a significant difference between evening and morning types ($F = 504.75$, $p < 0.001$). There is also significant interaction between type and time ($F = 51.93$, $p <$

0.001). There are also significant linear and quadratic functions (see Table 19). Again the morning graph is clearly linear, yet the quadratic function is still in question (see Figure 4).

Table 19

Source Table
Repeated Measures ANOVA

Source	Sum of Squares	df	Mean Squares	F	Tail Prob.
Mean	920415.63	1	920415.63	10219.26	0.0000
Type	45460.83	1	45460.83	504.75	0.0000
Error	8826.54	98	90.07		
R(1)	2450.00	1	2450.00	79.03	0.0000
R(1)T	2592.00	1	2592.00	83.61	0.0000
Error	3038.00	98	31.00		
R(2)	374.46	1	374.46	12.57	0.0000
R(2)T	564.54	1	564.54	18.95	0.0000
Error	2919.00	98	29.79		
R	2824.46	2	1412.23	46.47	0.0000
RT	3156.54	2	1578.27	51.93	0.0000
Error	5957.00	196	30.39		

R = time (prechildren, children, now)
T = type (evening, neither, morning)

To follow up with this finding, Cochran tests, to determine homogeneity of variance were done comparing the variances of the evening and morning types in all possible ways. The results are as follows:

evening types (across time) F = 0.4724 (N.S.)
morning types (across time) F = 0.4195 (N.S.)
evening and morning types
at prechildren time F = 0.7818 *
evening and morning types
at children time F = 0.7461 *
evening and morning types
at now time F = 0.7958 *.
(* significant at p < 0.01 level)

These findings indicate that there is homogeneity of variance within the evening subjects, and within the morning subjects. However when the evening types are compared to the morning types at all time points there are significant differences in variance, with the evening types having significantly greater variance at all times. Therefore the second hypothesis is supported.

Supplementary Findings

As pointed out previously (see pages 80 - 83), questions were raised concerning use of the published scoring system with American subjects. Using the prechildren scores, the published scores are, for all practical purposes identical to the scoring system developed and utilized in this study. However the published scores would have to be adjusted for the children and now time period questionnaires. This adjustment is most marked for the evening type classification, whose upper limit score would have to be raised 10 points above the published scores, and eight points above the scoring system developed in this study for the prechildren questionnaire.

The study's morning subject scores clearly fell within the published guidelines at all time points. The scores for morning types, the top 25% of scores, at each time point was actually more compressed than the published range. The upper limit for the neither classification scores also required

slight upward adjustment. However the changes in neither scores actually represent the adjustments necessitated in the morning and evening sub-samples, since the neithers are the "left over subjects". See Table 20.

For the entire sample at all time periods, which yields 600 questionnaire scores, the lowest 25% (evening types) scored 18 to 48, the middle 50% (neither types) scored 48 to 65, and the top 25% (morning types) scored 65 to 79. As compared to the published scores, these evening and neither score ranges are wider, and the morning scores are more compressed. Again this is consistent with earlier findings that the morning type sub-sample is more homogeneous than the other two sub-samples on many of the demographic variables. These additional findings are consistent with findings previously discussed (see page 95) which partially supported the first hypothesis, and demonstrated a significant difference in time of the questionnaire scores for evening and neither types.

Table 20

Questionnaire Scoring

	Published Scores*	Prechildren Scores	Children Scores	Now Scores
Evening	16 - 41	18 - 43	30 - 51	22 - 51
Neither	42 - 58	43 - 63	51 - 64	52 - 66
Morning	59 - 86	63 - 77	64 - 77	66 - 79

(* Horne & Ostberg, 1976)

As previously stated, the prechildren questionnaire scores determined in this study are practically identical to Horne and

Ostberg's (1976) published scores. Horne and Ostberg developed their scoring system on a sample of 18 to 32 year old males and females. Scores for this study were developed form a sample of females aged 41 to 60 who were, for the prechildren questionnaire, recollecting their life style while 16 to 37 years old. When the two similar aged samples are used scoring is, for all practical purposes identical. This finding further supports the validity of this questionnaire. The similarity of scores for equivalent aged samples, even though this study's prechildren scores were based on memory also further validates the retrospective design of the study.

A closer examination of the pattern of each subject's questionnaire scores was also undertaken. Nineteen (38%) of the morning types had no deviation of scores, as arbitrarily defined as a deviation of no more that two points from the prechildren questionnaire score. This is the dominant pattern demonstrated by the entire morning sub-sample. Ten (20%) of the morning subjects demonstrated a decline in scores on the children questionnaire, the decline ranging from 2 to 18 points. One of these subjects commented that while taking care of toddlers, she "often worked in the evening when they were not underfoot!" Perhaps this comment holds true for the other subjects in this category.

Nine morning type subjects (18%) showed the pattern originally hypothesized, that of having a higher score while caring for toddlers, and returning to or near prechildren

scores after the children had left. One of these subjects stated that due to arthritis she had retired (her current age was only 57), was slowing down, but was not tired and therefore stayed up late to watch television. She also reported needing more time to get going in the morning because of the arthritis. The only other subject who commented remarked that current work with computers left her "tired, but not physically exhausted".

The remaining 12 subjects (24%) fell into two groups. However all these subjects demonstrated little change in questionnaire scores. Five subjects (10%) had a decline in scores at the children and now scores. This decline varied from 3 to 8 points from prechildren to now scores. Seven other subjects (14%) demonstrated the opposite pattern, that of a steady increase in questionnaire scores from the prechildren time period. These scores varied only from 3 to 11 points over all three questionnaires. Four of these 7 subjects commented that they were morning types, had always been, and did not require alarm clocks. Perhaps these subjects, because of the small variation, should be combined with the first pattern described above, further confirming the linear pattern found in the morning sub-sample.

Neither type questionnaire scores fell into seven patterns. Twenty-five subjects (25%) fell into the largest group, whose scores increased from prechildren to children and from children to now questionnaires. Overall the scores increased from 9 to 25 points. Only two of these subjects

commented on their time preferences. One remarked that during her child rearing years "wakefulness was governed by their schedule and health". The other subject commented that "I was an evening/night person and my husband a morning person - subsequently I now am also a morning person". These remarks indicate that at least these subjects attribute their change in time preference to external forces, specifically children and husband.

A second group of 22 subjects (22%) demonstrated a linear pattern, as arbitrarily measured by a deviation in scores of no more than two points. Another group of 22 subjects (22%) demonstrated the originally hypothesized pattern of being highest at the children questionnaire, and then returning to a lower level at the now questionnaire. Scores increased from 2 to 14 points from the prechildren to children questionnaire, and decreased 1 to 19 points from the children to now questionnaire. Two of these subjects also commented that children and/or husbands really changed their time preference. Ten subjects (10%) demonstrated the opposite pattern of being most evening (lowest scores) on the children questionnaire. The children questionnaire scores were 1 to 10 points lower than the prechildren scores, yet the difference of prechildren to now scores were only 0 to 3 points. None of these subjects offered any comments.

Eight neither subjects (8%) had scores that rose from the prechildren to children time frame, and then remained at this

point. These scores changed from 5 to 19 points. Seven other subjects (7%) had stable scores from the prechildren to children questionnaires, and then rose 5 to 15 points at the now questionnaire. The remaining six subjects (6%) either declined from prechildren to children (4), or stayed stable (2), and had a further decline at the now time. None of the these final 22 subjects made any comments on their time preferences.

The evening type subjects fell into five groups. The largest group, 23 subjects (46%), demonstrated scores that rose at the children time and continued to rise at the now time. Overall the scores rose 3 to 23 points from prechildren to children, and an additional 3 to 23 points from children to now. This is the pattern demonstrated by the means of the evening type scores. One of these subjects commented that when she had children she would have "killed to sleep late", now that she can, she can't. One other subject stated that she was a night person, and then by choice became a morning person. These comments again cloud the issue of internal (biological) vs. external (social) forces influencing time preference.

A second group of 15 evening type subjects (30%) demonstrated the hypothesized pattern of being the highest at the children time point. The children questionnaire scores were 5 to 36 points higher than the prechildren scores, and then decline 3 to 24 points on the now questionnaire. Four subjects commented that although their time preference had

changed, this was due "primarily because of commitments rather than because of `maturation'". This was the pattern originally hypothesized, and although seen in a number of subject, it was not the dominant pattern. From the comments offered, these subjects perceive the change to be due to the pressures of social and family commitments.

Ten evening subjects (20%) had scores that rose from prechildren to children by 4 to 34 points and then remained stable to the now questionnaire. Perhaps this group should be combined with the first group of evening subjects whose scores continued to rise from the children to now questionnaire. This would yield a very dominant pattern (66%) of continuing rising scores for the evening type person. The two remaining subjects had scores that declined from the prechildren to children time period, by 3 and 4 points. One subject's scores continued to decline at the now time, while the other subject's score rose 11 points higher than her prechildren score. One of these subjects also commented that "waking time depends almost totally on the plans for that day".

It can be seen that the subjects within the different sub-samples show a variety of score change patterns. The neither sub-sample has the most patterns. This may be because the neither sub-sample has the most subjects, or it may be consistent with the inability to clearly classify these people. It is also remarkable that numerous morning subjects commented on their consistency through life. Only three evening subjects

made a similar statement. Many more evening subjects, as noted above, remarked that their time preference had changed, and they attributed this to children, social commitments, and "reality". These comments from the subjects are consistent with the findings of the study, further validating the design and methodology.

In closer examination of A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms, there appears to be three questions that may be especially significant in classifying an individual's time preference. Question 11 asks the individual to pick a peak performance time for a two hour mentally exhausting task. The majority of morning type subjects chose 8:00 to 10:00 AM (86% at prechildren and now times, 80% at children). The remaining morning types chose 11:00 AM to 1:00 PM. No morning type subject chose a later time. For the evening and neither subtypes answers were much more diversified. The majority of neither types chose 11:00 AM to 1:00 PM (62%, 58%, and 48% respectively), with evening types demonstrating similar responses (54%, 64%, and 46% respectively). Although there is quite a bit of overlap in responses between neither and evening sub-sample, 90% of all subjects at all time periods wish to face mentally exhausting tasks between 8:00 AM and 1:00 PM. Perhaps patient and family teaching would be most effective if conducted during this time period.

Question 15 asks the individual to indicate the two hours

that would be at peak performance for hard physical work. Findings for question 15 were identical to those for question 11. All of the morning type subjects chose 8:00 AM to 1:00 PM, with 82% to 86% choosing 8:00 to 10:00 AM. Again evening and neither types are much more diversified, with approximately 50% of each of these types choosing 11:00 AM to 1:00 PM. Again this single question indicates that for this age sample, physical therapy and rehabilitation would be most agreeable and possibly effective in the late morning to very early afternoon.

Question 19 asks the individual to rate themselves as to whether they are definitely morning, rather morning, rather evening, or definitely evening. The morning type subjects all chose definitely or rather morning on the prechildren and children questionnaires. Two of these subjects identified themselves as rather evening on the now questionnaire. The scores for these two subjects on the now questionnaires did decline into the neither type range. For the neither type subjects, they chose all options, with 49% and 44% choosing rather morning on the prechildren and children questionnaires. Forty-four percent of these subjects called themselves as definitely morning on the now questionnaire. All but two of the evening types called themselves rather or definitely evening on the prechildren questionnaire. By the now questionnaire 14% of these subjects called themselves definitely morning, another 32% called themselves rather evening. These self reportings of their time preference types

are consistent with the statistical analysis described earlier, and accurately reflect the graph seen in Figure 4. This further validates the questionnaire and the study's design, and indicates that when people are asked to be self reflective can accurately identify their time preference.

Chapter 4

DISCUSSION AND IMPLICATIONS

Discussion

Much work has been conducted which documents the occurrence of biological rhythms in all aspects of life. Researchers have shown that an individual's time preference for morningness or eveningness parallels the individual's body temperature curve, food intake, and urinary catecholamine excretion. Other researchers have shown that biological rhythms are remarkably stable through varying environmental conditions. Biological rhythms also appear stable across the life span, yet research is limited in this area.

Preliminary studies have been conducted on adult developmental stages. These studies have shown that adults travel through distinct stages, as do children and adolescents. Each stage has its own challenges and tasks to be met and completed. This study arose when many hospitalized patients reported being an evening type when they were adolescents and young adults, but changed to being a morning type when they had children and job responsibilities. This study was designed to investigate whether a person's time preference is a stable circadian rhythm, or whether time preference is dependent upon adult developmental stage and therefore a means to adapt to changing responsibilities and environment.

This study recruited 200 American born women, between the

ages of 40 to 60 years. All subjects had at least a six month period between finishing school and bearing a child, bore primary child rearing responsibilities for at least one child, and had at least the previous six months free of child rearing responsibilities before participating in the study. All subjects completed a demographic data questionnaire and A Self-Assessment Questionnaire To Determine Morningness-Eveningness In Human Circadian Rhythms for three periods in their lives. The subjects were guided back to a mind set when they had finished full time school but did not yet have children, to when they had pre-school children, and back to the present. The sequence of time sets was randomized. At each time set, each subject completed the morningness-eveningness questionnaire to document her time preference.

It was hypothesized that an individual's time preference is not an inherent biological or circadian rhythm, but rather is an aspect of her developmental stage. It was specifically hypothesized that subjects would be most morning (highest score) while raising pre-school children. This hypothesis was not fully supported. Utilizing a repeated measures analysis of variance, questionnaire scores for the morning type sub-sample were linear at all time points, not showing any significant deviation at any time point. This indicates that for this sub-sample, adult developmental stage and/or life demands did not influence time preference. For the neither and evening sub-samples, there was a significant increase in scores (more

morningness) from the prechildren to children questionnaire. However their scores continued to rise, although to a smaller extent from the children to now questionnaire. This data partially supports the original hypothesis, indicating that adult development and life demands do influence an individual's time preference across the life span.

The second hypothesis stated that evening types would show greater variance in questionnaire scores than the morning types. Again using a repeated measures analysis of variance, this hypothesis was supported. Follow up Cochran tests confirmed that the evening type subjects had statistically significant greater variance than the morning types.

Perhaps the morning type subjects did not show a rise in scores on the children questionnaire due to a ceiling effect. Although this is a possible explanation, there was still a nine point cushion between the maximum score recorded by any of the subjects and the questionnaire's maximum score. None of the subjects filled this gap. It is more likely that these subjects were already living a life style that was compatible with the demands created by raising children and/or holding a job, and therefore did not have to change their time preference. It is also interesting that the morning type subjects were more homogeneous on many of the demographic variables. Does this indicate that a morning type individual is more consistent and less flexible than other types for time preference as well as other personality characteristis?

The neither and evening type subjects did demonstrate a dramatic increase in questionnaire scores at the children time period. It is believed that the life demands created by having children, and all the child rearing responsibilities, prevents the individual from sleeping in and staying up late. Although it was hypothesized that questionnaire scores would return to their prechildren level (more evening) this was not found. The reasons for this observed morningness bias can only be speculated on. However it appears reasonable to consider that other factors, such as the woman's employment, spouse's time preference, previously formed social or community commitments, and/or comfort and security in an established life style also influence time preference in later years. Perhaps a longer time delay, when all subjects and their spouses were retired and freed from other commitments for a number of years, would demonstrate the originally hypothesized pattern. It would be interesting to see if this finding would also be found in a sample of evening subjects who did not have children or any child rearing responsibilities.

It is also interesting that the evening type subjects were younger than the other two sub-samples, and more heterogeneous in many of the demographic variables than the other two sub-samples. An earlier study (Froberg, 1977), comparing evening and morning type subjects also found the evening types to be younger than the morning types. No other study which examined morning and evening type subjects reported examining, or

comparing the variety of demographic variables that were examined in this study. It has been reported by Akerstedt and Froberg (1976), and Foulkard, Monk and Lobban (1979) that morning people have a great deal of difficulty in altering their sleep patterns, and adjusting to shift work. In contrast, evening people readily adapt to shift work and other changes in their daily schedules. Is the adaptability previously demonstrated in evening people, reflected in the diversity seen in the current evening type sub-sample? Are evening type individual's inherently more flexible and/or variable, as a personality characteristic, than morning types? Is the change in time preference, as demonstrated in this study, a further reflection of this variability, adaptability, or flexibility? These findings certainly raise the issue of whether personality characteristics influence time preference, and if so, in what way, and to what extent.

It has been previously discussed that there are two pacemakers controlling biological rhythms. The Y pacemaker controls skin temperature, the release of growth hormone, urinary calcium excretion, rest/activity patterns, and slow wave sleep propensity. The Y pacemaker's circadian rhythm is 29.3 hours, closer to the longer circadian rhythm hypothesized for evening people. The second, X pacemaker controls REM sleep, cortisol secretion, urinary potassium excretion, and body temperature, and has a circadian rhythm of 24.5 hours. Kronauer et al. (1982), and Moore-Ede (1983) state that since

the X pacemaker is closer to the internally synchronized free-running period than the Y pacemaker, the X exerts more influence on Y, than Y on X. Perhaps in evening types this coupling is not as strong, or even reversed with Y exerting a greater influence on X. Perhaps the life demands, or biological demands involved with bearing and raising children change this coupling. This may cause evening people to become more morning by shortening their free running period. This question can only be verified by examining the rhythms controlled by the X and Y pacemakers along with time preference across the life span of evening people.

This study questioned whether or not time preference is a biological rhythm, or whether it is one further component of adult development. For 75% of the sample studied, time preference did change across the life span suggesting that time preference is not a true biological rhythm, as demonstrated by its adaptability. The previously held assumption that time preference is a biological rhythm is obvious by its correlations with true circadian rhythms such as body temperature. However it is also interesting that time preference demonstrates two clearly different patterns, the morning and evening types, and another harder to distinguish type, the neithers. No other circadian rhythm, such as hormone release, or urinary excretions,had been shown to have multiple distinctive patterns. This fact alone marks time preference as being different from other circadian rhythms. The finding that

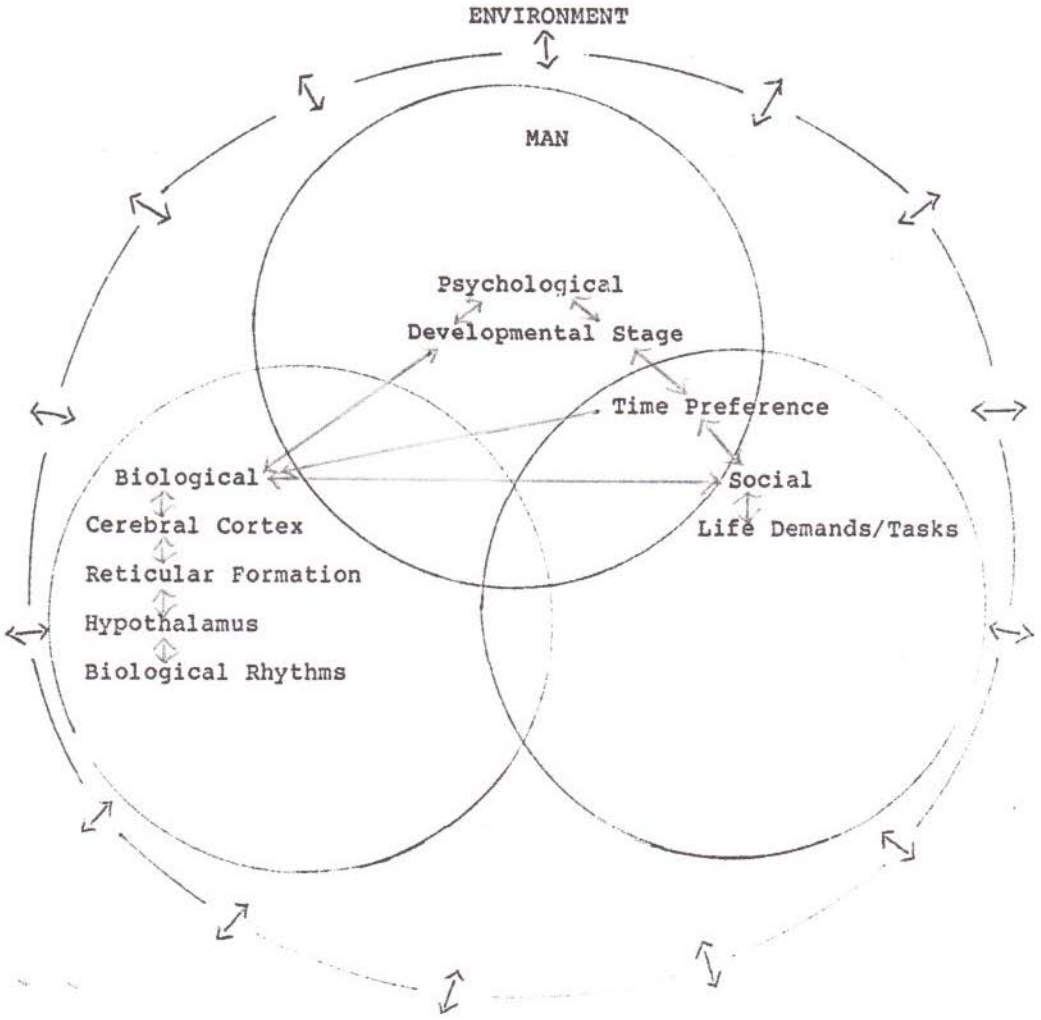
time preference is not a true biological rhythm, that it changes in the majority of women according to their developmental stage, yet it influences or is influenced by true circadian rhythms strengthens the interconnectedness of the biological, social, and psychological realms of human beings, as shown in Figure 1. However Figure 1 requires modification in the placement of time preference, see Figure 5.

Implications

This study has demonstrated that time preference does change across the life span. Nurses and other health professionals can use this information and modify life style and life demands to maximize therapeutic regimens. For example clients with diabetes can, over time, modify their time preference to maximize their therapeutic regimen, thereby normalizing blood glucose levels. Other clients can be counseled to reduce stress created by life demands by such techniques as napping with their children during the day and then staying up later in the evening to complete tasks and have private time. Or clients can be helped to rise earlier and complete tasks or enjoy private time before the children wake. Family dynamics may also be influenced by family members' individual time preference. Is the divorce rate and/or incidence of child abuse influenced by synchronization or desynchronization of time preference among family members?

Figure 5

Revised
Model of the Interaction of Inherent Circadian Rhythms and Adult Development



It is conceivable that family relationships could be maximized and tensions minimized by assisting clients to modify their time preference to provide for private time, as well as time for interaactions while all concerned are alert and functioning. Perhaps time preference also plays a role in tensions and conflicts in work situations. As culture appears to influence time preference, this may be especially acute in culturally diversified settings.

This study has also demonstrated that evening type people tend to be younger than neither and morning people. It has also been demonstrated that specific questions within the questionnaire correspond closely to the individual's time preference. Morning types were especially reliable at labeling themselves for time preference. They also were consistent in choosing early morning (8:00 to 10:00 AM) to perform hard physical and mental tasks. For morning type individuals, physical therapy and rehabilitation, and patient teaching should be conducted at this time of maximum effectiveness. Neither types preferred these activities most closely to noon (11:00 AM to 1:00 PM). Evening types preferred mid to late afternoon times for these activities at the prechildren time period, but then as their time preference changed, so did their time preference for these activities. For evening types raising children or older, teaching and therapy would be most effective if conducted in the late morning or early afternoon. Patients should be questioned as to their time preference for

teaching and therapy, and this should be followed to the greatest extent possible to maximize the effectiveness of these interventions.

All hospitalized patients tend to receive medication on a preset time schedule. Specifically, sedatives are usually administered at 10:00 PM. This may be an appropriate time for some morning and neither type clients, but may also be too late for other morning types, and too early for evening type clients. Administering sedatives at times when the individual is not receptive to their effects may negate their effects, or be more disruptive over the short term by causing desynchronization of other biological rhythms, leading to increased stress, and fatigue, with a concomitant diminishing of recuperative powers, and an increased potential for further illness and injury.

It would also be useful to determine if voiding patterns are different for people with different time preferences. For a very simplified example, do morning people defecate in the morning, and therefore nursing intervention should be planned for this in mind, while evening types do not? Perhaps morning people would be more receptive to cathartics administered in the evening to be effective in the morning. For evening people these cathartics would be more effective if administered in the morning to be active in the evening. Perhaps there are other medications that should be administered according to the individual's time preference. None of these questions can be

answered here, so much research remains to be done.

Recommendations For Future Research

Although this study has demonstrated that time preference is not a true circadian rhythm, rather dependent upon life demands, it has also raised many more questions requiring answers. Future research questions include:

1. Can these results be replicated using three cohorts, women who had finished school but who do not yet have children, women who are currently raising pre-school children, and women who are free of all child-rearing responsibilities. This would remove any effect of memory, which exists in the current study.

2. Replicate the study using a sample which consists of women who are living in a middle to upper-class retirement village. This sample would be free of financial worries, and also be totally free of work, child-rearing, and social pressures for a longer period of time that the sample examined in the current study. Perhaps this would demonstrate the time preference pattern originally hypothesized.

3. Replicate the study using a sample of men. It has been shown in the review of literature that developmental stages of women are different from those of men. The different sexes

have different tasks and demands to meet at each developmental stage. Does time preference change in men across the life span, and if so how?

4. Replicate the study using a sample of evening type women who do not have children, or child-rearing responsibilities. Is the change in time preference demonstrated in the current study due to life demands, adult developmental stage, or simply aging?

5. Do evening types have different personality characteristics than morning types? Specifically it has been shown that evening type subjects in this study were more diverse on the questionnaire scores, and on many of the demographic variables. Previous research has shown that evening types adjust to shift work much more easily than morning types. Does this indicate that evening types are inherently more flexible and adaptable than morning types?

6. As evening subjects' time preference changes, are there parallel adjustments in the biological rhythms controlled by the Y pacemaker? The question was previously raised as to whether the coupling between the X and Y pacemaker changes when a women has children. This could be answered by studying rhythms of skin temperature, growth hormone, urinary calcium excretion, rest-activity pattern, and slow wave sleep

propensity along with time preference across the life span.

7. Do morning and evening type clients demonstrate an improved outcome when teaching and physical therapy are performed at times of their peak performance?

8. Do evening and morning type individuals react to medications differently when they are administered at the same time? Conversely, should certain medications be administered at different times for maximal effects in morning types and evening types?

9. Do evening types and morning types show different patterns of illness or injury? Halberg (1983) reported circadian rhythms for deaths in surgery, air accidents, and spontaneous births. Does a person's time preference influence this circadian rhythm of illness and injury?

10. Compare the daily activities and energy levels of morning, neither, and evening type subjects through use of logs maintained by the subjects.

11. Do family members have similar or different time preferences? What are the rates of divorce and child abuse among families with similar time preferences and families with different time preferences?

Conclusion

This study questioned whether or not time preference is a true biological rhythm, or whether it is an apparent rhythm dependent upon adult developmental stage. It has been demonstrated that an individual's time preference for 75% of the sample studied did change according to adult developmental stage. It is felt that the 25% of subjects that did not show a change in time preference were already following a life style, including time preference, that is compatible with life demands created by having and raising children. This finding that time preference is not a true biological rhythm, that it adapts according to life demands, yet it is influenced or influences true biological rhythms, strengthens the concept of the wholeness of the human being, with strong connections between all aspects of the individual.

Nurses are now challenged to utilize this information to help in scheduling nursing interventions to maximize their clients' potential, maximize medication effects, and identified times for the highest likelihood of an illness or injury to occur according to time preference and are therefore challenged to intervene accordingly. As with any research study, more questions were raised than actually answered, and much future research is needed.

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Appendices

Appendix A

Number _____

1. Your current age. _____
2. Your age when you finished full-time school. _____
3. Your age when you had your first child. _____
4. Your age when your last child left home. _____
5. Sex and age of all your children. _____
   _____
6. Are your currently: (check one)
   Married ____ Divorced ____ Widowed ____ Never Married ____
7. Total number of years married. _____ (If applicable)
8. Highest grade in school completed. _____
9. Your current occupation. _____
10. What is your waking time? _____
11. Is this waking time your choice/or required? (circle one)
12. What is your husband's waking time? _____ (If applicable)
13. Is your husband's waking time his choice/or required? (circle one)
14. Does your husband's waking time disturb or bother you in any way? Yes No (circle one) If yes, please explain:
    _____
    _____
    _____

Comments:

Appendix B

A SELF-ASSESSMENT QUESTIONNAIRE TO DETERMINE MORNINGNESS-EVENINGNESS IN HUMAN CIRCADIAN RHYTHMS

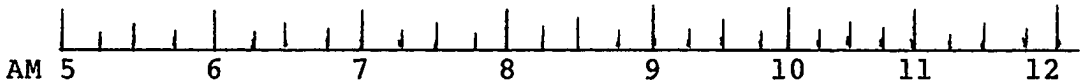
J.A. Horne and O. Ostberg

Instructions:

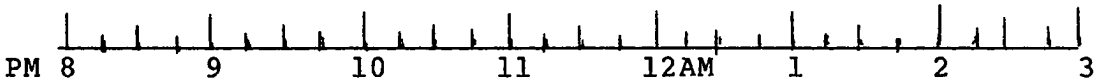
1. Please read each question very carefully before answering.
2. Answer ALL questions.
3. Answer questions in numerical order.
4. Each question should be answered independently of others. Do NOT go back and check your answers.
5. All questions have a selection of answers. For each question place a cross 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.

Questionnaire:

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...☐
Slightly dependent.....☐
Fairly dependent.....☐
Very dependent.....☐

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

Not at all easy....☐
Not very easy.....☐
Fairly easy.....☐
Very easy.....☐

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

Not at all alert....☐
Slightly alert.....☐
Fairly alert.....☐
Very alert.....☐

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

Very poor.....☐
Fairly poor...☐
Fairly good...☐
Very good.....☐

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

Very tired.....☐
Fairly tired.....☐
Fairly refreshed...☐
Very refreshed.....☐

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

Seldom or never later..... ☐
Less than one hour later... ☐
1 - 2 hours later..... ☐
More than two hours later.. ☐

9. You have decided to engage 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 AM. Bearing in mind nothing else but your own "feeling best" rhythm how do you think you will perform?

Would be on good form..... ☐
Would be on reasonable form... ☐
Would find it difficult..... ☐
Would find it very difficult.. ☐

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 AM..... ☐
11:00 AM - 1:00 PM.. ☐
3:00 - 5:00 PM..... ☐
7:00 - 9:00 PM..... ☐

12. If you went to bed at 11.0 PM at what level of tiredness would you be ?

Not at all tired.... ☐
A little tired..... ☐
Fairly tired..... ☐
Very tired..... ☐

13. For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which ONE of the following events are you most likely to experience?

Will wake up at usual time and will NOT fall asleep.....	☐
Will wake up at usual time and will doze thereafter.....	☐
Will wake up at usual time but will fall asleep again....	☐
Will NOT wake up until later than usual.....	☐

14. One night you have to remain awake between 4.0 PM - 4.0 AM 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.....	☐
Would take a nap before and sleep after.....	☐
Would take a good sleep before and nap after.....	☐
Would take ALL sleep before watch.....	☐

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 AM.....	☐
11:00 AM - 1:00 PM...	☐
3:00 - 5:00 PM.....	☐
7:00 - 9:00 PM.....	☐

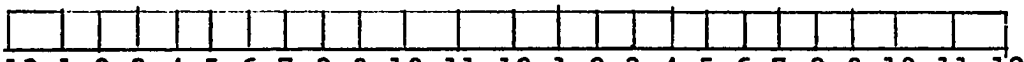
16. You have decided to engage in hard physical exercise. A friend suggests that you do this for one hour twice a week and the best time for him is between 10:00 - 11:00 PM. Bearing in mind nothing else but your own "feeling best" rhythm how well do you think you would perform?

Would be on good form.....	☐
Would be on reasonable form...	☐
Would find it difficult.....	☐
Would find it very difficult..	☐

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

12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Midnight Noon Midnight

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



12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Midnight Noon Midnight

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.....
Rather more a "morning" than an "evening" type.....
Rather more an "evening" than a "morning" type.....
Definitely an "evening" type....