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Biorhythm theory proponents believe that humans have a 23-day physical cycle, a 28-day emotional cycle, and a 33-day intellectual cycle. According to biorhythm theories a person in the positive portion of any single cycle, the performance potential is enhanced for those tasks related to that particular rhythm. When each cycle crosses the baseline from positive to negative, or vice versa, that point represents a critical day in that particular cycle. During critical days, the performance potential is considered highly unstable. The theory proposes that incidents of human error are especially numerous on critical days.

The purpose of this study was to determine if athletic injuries of female college gymnasts become more numerous with respect to critical days of physical, emotional, and/or intellectual biorhythm cycles. Data were collected from a sample of fourteen injured female gymnasts of Oregon

State University. A total of thirty injuries were recorded over a period from 1981 to 1984.

Critical days were calculated for each of the injured individuals in accordance with two definitions of critical days. Chi-Square with Yates' correction for continuity was employed to determine statistical significance at the .05 level of confidence.

In each instance the hypothesis testing rejected the null hypothesis. The number of injuries which occurred during critical days or negative phases of biorhythm cycles were not more than the number of injuries which occurred during non-critical days or positive phases. Therefore, the biorhythm theories were not supported by the data of this study.

THE RELATIONSHIP BETWEEN BIORHYTHMS AND INJURIES IN FEMALE COLLEGE GYMNASTIC PARTICIPANTS

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Kai-Sun Chiang

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Chairman of Department of Physical Education

Redacted for Privacy

Dean of School of Education

Redacted for Privacy

Dean of Graduate School

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CHAPTER I

INTRODUCTION

Since the 1960's various theories related to biorhythms have received considerable attention. Popular among these theories is that individuals are more susceptible to injury producing accidents during certain phases of the biorhythm cycle than at other times in the cycle.

Although extensive research has been conducted to document the existence of biorhythm in plants, animals, and humans, relatively little research has been directed toward exploring theories related to biorhythms and athletic injuries (19,41,64,27,28).

The development of the biorhythm theory is attributed primarily to the work of Swoboda (58) and Fleiss (14) in the early 1900's. According to the biorhythm theory, a human has 23-day physical, 28-day emotional and 33-day intellectual sinusoidal cycles. These three endogenous cycles are said to begin at the moment of birth, and to recur consistently throughout one's life until death(59).

The physical cycle relates to activities of a physical nature. It originates in muscle cells and myofibers, affects physical factors such as strength, coordination, speed, basic bodily functions, as well as the sensation of well being. The mid-point of the cycle is

11.5 days (20).

The emotional cycle influences situations of high emotional content. It originates in the nervous system, governs creativity, sensitivity, mental health, mood, perceptions, and possibly conception. The mid-point of the cycle is 14 days (20).

The intellectual cycle takes on importance in performances which require cognitive activity. It originates in the thyroid or pineal gland, regulates memory, alertness, receptivity to knowledge, and logical or analytical mind functions. The mid-point of the cycle is 16.5 days (20).

When a cycle is in the positive portion of oscillation, energy is considered to be discharged. Thus, performance potential is enhanced for those tasks related to this particular rhythm. When each cycle crosses the baseline from positive to negative, or vice versa, that point represents a critical day. Critical days last for 24 hours and comprise about 20 percent of the days in an individual's life (64). During critical days, performance potential is considered highly unstable. It is believed that incidents of human error are especially numerous on critical days. The criticality increases as the number of simultaneously crossing cycles increases (60).

Recent reaearch has focused on the application of biorhythms to sports. The phases of biorhythm cycles have

been reported to provide explanations for good and bad performances in individual sports such as cycling, golf, track and field, swimming, weightlifting, and motor racing(9,21,61, 56,65). Biorhythms have also been utilized to interpret wins or losses in dual sports such as tennis and boxing(33,38), and even in team sports such as soccer and football(21,53, 63). In contrast, studies have reported that biorhythms do not correlate well with the quality of athletic performances (5,10,17,25,29,31,32,34,37,43,46,48,52,51,49), nor with football injuries(28,64).

Apparently, injury studies related to biorhythms tend to focus on contact sports(19,27,28,64). Very few investigations have been conducted which are associated with non-contact sports. Both team and individual contact sports, due to their exogenous violence, as would be expected, revealed a greater incidence of injuries than did non-contact sports(6,18,22). It should be noted that where injuries are incurred in contact sports the injuries frequently are caused by someone other than the injured person. On the other hand, with individual sports such as gymnastics the injuries typically are almost always caused by the persons own actions. Therefore, if biorhythms can actually affect the incidence of sport injuries, it seems reasonable that biorhythms might apply more to non-contact sports than to contact sports. Research concerned with the relationship between biorhythms and non-contact sports injuries needs to be examined further.

Purpose of Study

The purpose of the study was to determine if athletic injuries are related to physical, emotional, and/or intellectual biorhythm cycles with female college gymnasts of Oregon State University. This study was also designed to determine the extent to which the three biorhythm cycles or their combinations contribute to gymnastic injuries.

Null Hypotheses

The results of the study were analyzed to determine if the following null hypotheses should be retained or rejected:

1. The number of injuries which occur on non-critical days is not different from the number of injuries which occur on critical days.

2. There is no difference in the number of injuries that occur during the different phases of the physical biorhythm cycle.

3. There is no difference in the number of injuries that occur during the different phases of the emotional biorhythm cycle.

4. There is no difference between the number of injuries that occur in different phases of the intellectual biorhythm cycle.

5. There is no difference between the numbers of

injuries that occur in different phases of the combination of physical, emotional, and intellectual biorhythm cycles.

Limitations

1. Data were collected only on Oregon State women varsity gymnasts.

2. Data were only collected for a period of four years between 1981 to 1984.

3. Only those injuries were recorded which were considered serious enough to require the services of an athletic trainer or physician.

4. Data were not collected indicating the exact time of birth which thereby partially jeopardizes the accuracy of determining critical days.

5. No restrictions were placed on non-school related activities of the athletes.

6. No data were collected relevant to menstrual period events.

7. Inferences are limited to Oregon State women gymnasts involved in this study.

8. Results of this study should not be used to infer to other ages of athletes.

9. Results of this study should not be used to infer to women athletes in other sports.

10. Results of this study should not be used to infer to male athletes.

Assumptions

The following assumptions were made in this study:

1. The injuries were the result of accidents caused by the gymnast herself.

2. The injury dates of the subjects were correct.

3. The birthdates of the subjects were correct.

4. Each subject participated to her maximun ability during practice or competition.

5. "Reinjuries" were assumed to be new injuries when rehabilitation had been considered satisfactory to permit continued participation.

Definition of Terms

1. Biological rhythms: The rhythmical oscillation of physiological changes in the human body which were caused by recharge or discharge within the cellular system (60).
2. Biorhythms: The consistent recurrence of physical, emotional, and intellectual cycles (60).
    A. Emotional biorhythm: The 28-day rhythm that governs the nervous system. It affects the moods, sensitivity, and creativity of man(60).
    B. Intellectual biorhythm: The 33-day rhythm which pertains to traits generally associated with reasoning power, mental responsiveness, understanding, and concentration (60).

C. Physical biorhythm: The 23-day rhythm that affects expression of man's physical strength, endurance, energy, resistance and physical confidence (60).

3. Cycles: The critical phase (critical day), the negative phase, and the positive phase.

A. Critical phase (Critical day): The switch-point day or days; the first day of a new cycle, when a rhythm changes from its high or discharge phase into the recuperative phase (60).

B. Critical day (Critical phase):

Definition A: A 24 hour critical period. Thus, two days are considered critical in each cycle (49).

Definition B: The first day of any cycle or the mid-point day of any cycle. The critical days for each cycles are: physical 1,12,13; emotional 1,15; intellectual 1,17,18(64).

C. Positive phase: The ascending or discharge period(60).

D. Negative phase: The recharging or recuperative period(60).

4. Endogenous. Independent of external rhythmic stimuli; originating from within the organism(57).

5. Exogenous. Dependent upon external rhythmic stimuli;

originating from outside the organism(57).

6. Gymnastic injury. An injury occurring during a practice or competition of sufficient seriousness to prevent the gymnast from participating for a minimum of one day.

    A. Acute injury: An injury having an immediate relatively severe cause(11).

    B. Chronic injury. An injury occurring during a practice or competition that persists over a long period of time before complete healing (11).

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature reviewed has been arranged into five major categories:

1. The development of the biorhythm theory
2. The physiological basis of biorhythms
3. Studies on biorhythms and athletic performance
4. Studies on biorhythms and athletic injuries
5. Summary

The Development of the Biorhythm Theory

Philosophers, physicians and scientists have always been concerned with cycles and rhythms as clues to the nature of man's life on earth. In the time of the Greek physician Hippocrates, there was an awareness and a respect for the rhythms of life. Hippocrates urged his colleagues and his students to observe the "good" and "bad" days among the "healthy" and the "ill" and to consider them in the treatment of patients(20).

The development of biorhythm theory is primarily attributed to the work of University of Vienna psychology professor Hermann Swoboda and to Berlin physician Wilhelm Fliess in the early 1900's (20). They involved themselves in massive documentation of symptomatic history in their

patients by recording periods of anxiety, outbreak of disease, tissue swelling, fevers, and heart attacks. In 1904, Swoboda(58) concluded that all of these physical phenomena appeared to recur rhythmically. He found a certain rhythmical turning point in asthma attacks. He proposed the existence of two biorhythms, a 23-day physical cycle and, a 28-day emotional cycle. He viewed these as influencing the rhythmical fluctuations that govern the ups and downs in human life. In Berlin, Fliess (14) came to the same conclusions. He recorded his theory on the existence of a 23-day biorhythm and a 28-day biorhythm in his publication -- The Course of Life.

The 33-day intelligence biorhythm was determined in the 1920's by Alfred Teltscher, an Austrian doctor of engineering who taught at the University of Innsbruck (20). Curious about the good and bad days his students had, he collected extensive data regarding student birthdates and examination performances and postulated a 33-day intellectual cycle. Teltscher's intellectual cycle was a biorhythm that affected intelligence, memory, mental alertness, logic, reasoning power, reaction and ambition.

In 1929, two American professors of the University of Pennsylvania, Dr. Rexford B. Hersey and Dr. Michael J. Bennett, came up with research findings that supported Teltscher's 33-day intellectual biorhythm theory. They noted, in massive studies of behavior patterns of works, rhythmic

swings in mood occurring in 33-day cycles which were apparently unrelated to external events (26).

The major force in the explanation of biorhythm theory is regarded to George S. Thommen (59). He devoted himself to biorhythmic research for over fifty years.

Since 1970's, the promotion of biorhythm theory has become a large industry. Biorhythm books, biorhythm computers, biorhythm watches, bio-cards, bio-calculators and other assorted paraphernalia have been produced and marketed. Also, the determination of an individual's biorhythm status has taken on the dimensions of a fad (51).

The Physiological Basis of Biorhythms

Biorhythm theory is consistent with observations of fundamental biological rhythms. Biological rhythms are basic, relevant and ever present physiological phenomena in human life and present in animals. For example, the relationships between biological(physiological) rhythms and major geophysical cycles of one day (24 hours), one lunar day (interval between successive moon rises), one month(29.5 days), and one year(365¼ days) have been documented in many animals (60). It also been found that many of the biological functions of man follow rhythmical cycles. Body Temperature and heart rate follow a daily rhythm, being lowest in the morning and highest during the late afternoon and evening. Human epidermis replaces lost cells in a similar rhythmic fashion(55).

Energy metabolism, represented by physiological and biochemical activity, of most animals displays a systemic periodic variation (3,23,30, 35).

Periodic patterns of oxygen uptake have been observed in various species (8,44,47). Circadian variation was found in human heart rate, pre-ejection period and Q-T interval during rest (62). One factor for such periodicity may be a threshold level of some particular substance in a subcellular compartment, for example,some phase of the endoplasmic reticulum or mitochondria oxdative enzyme activity (15). Another factor may be a periodic variation in the function of the oxygen transport system (8,44,47). A critical determinate of functional potential is oxygen transport capacity and intermediary metabolic power($\dot{V}O_2$ max). However, no relationship was found between female maximal aerobic power and the 23-day physical biorhythm cycle (13).

Studies on Bioryhthms and Athletic Performance

Since 1970's, promoters of bioryhthm theories have focused on the application of biorhythms to sport. Biorhythm theories have been used to explain either good or bad performance in sports. On the other hand, scientific researchers have suggested that biorhythm theories must be viewed with skepticism until the careful testing of large numbers of subjects with rigorous statistical evaluation of data is conducted. For clarity,

two different advocacies will be reviewed seperately:

Supportive Studies to Biorhythm Theory

Rummel(54) evaluated team and individual biorhythms at the 1975 AIAW National Basketball Championships and found that teams which were winners were more often higher biorhythmically than were the losers. Additionally, approximately 85% of the individual and team biorhythms computed matched the performances of the individuals and teams. Wallerstein and Roberts (63) formulated a team bio-curve concept taking into account the biorhythm cycles of each player on a team or subset of a team. Successful predictions were then made concerning the outcome of a number of games involving top college and professional teams.

Martin (40) investigated the relationship of biorhythms to competitive swimming performance and found that most of the swimmers displayed a close relationship between the emotional biorhythm cycle and winning performance. Assessment of the 31 swimmers indicated best performances occurred when they were emotionally high in their biorhythm cycles. Wenos and Wenos (66) examined the biorhythms of a number of world class athletes and concluded that the athletes tended to perform poorly during the down part of their cycles. The authors were decidedly optimistic about the use of biorhythm theory in the future, such as in programming training and in making

competition schedules.

Martin and his colleagues (41) compared the biorhythms of 23 runners in 1395 consecutive racing performance over a 2½ year period with finish times and with the runners' subjective grades of each performance. The sample of 23 runners ranged from 800 meters to the marathon. A significant relationship was found between the emotional cycle and performance time, with faster performances during low phases of the emotional cycle. Performance times negatively correlated with the emotional biorhythm Cycle. The reason for this relationship is unclear.

Research incorporating related motor skills (reaction time, both simple and complex) has been reported by Neil and Sink (45). Three subjects were tested on a reaction time task, classified as an information processing task, on a daily basis over a period of 70 days. The performance measures obtained included reaction time, movement time, and information processing rate. The latter two measures were determined using Hick's Law, as applied by Neil and Sink. Hick's Law, "... suggests that subjects gain information, in the technical use of the term 'information', at a constant rate". The results obtained indicated a strong relationship between performance and the periodicities suggested by biorhythms.

Francis (16) studied 25 boys aged 12-14 who were

participating in basketball, track and field, or weight-lifting activities in a junior high school. He kept a record of the weights lifted in the bench press, clean and jerk, and leg press over a period of 61 days. Student's t test was used to determine the significance of the differences between the means during the high and low phases of the cycles. He found that during the high phase of the physical cycle, performance in the three test lifts was superior at the .05 level to that during the low phase. He suggested that strength training should be stressed during the positive phase of the physical cycle and technique training during the negative phase.

Studies Contradictory to Biorhythm Theory

Results of controlled studies dealing with biorhythms and athletic performance suggest that biorhythm theory must be considered with suspicion. The following controlled studies reported in the literature have in general failed to validate the claims made by proponents of biorhythm theories.

Chase (17) examined professional women golfers in approximately 260 matches and found no correlations between performance and any combination of biorhythm cycles. Quigley (49) examined the relationship of biorhythms and performance in Australian track and field records from 1969-1977 (n=330). His results showed no evidence of the existence of biorhythms or their effects on performance.

Quigley (50) further calculated biorhythm amplitudes for all men's metric world records in track and field from 1913 to 1977 (n=700). No relationship could be found between record-breaking performance and the biorhythm phases.

Hall (24) investigated track and field events for an entire season. No correlation between biorhythms and performance could be found for any of the 16 subjects. Louis (36) examined the relationship of biorhythms and performance in baseball and boxing. He examined the biorhythms of baseball players who had pitched no-hit games (100 no-hit games between 1934 and 1975), and boxers in heavy weight championship fights (100 title fights, 1899-1976). No significant correlations between biorhythm readings and individual performances were found in either study.

Mance (39) studied the relationship of the 23-day physical cycle to motor performance and motor proficiency. Motor performance involved the Purdue Pegboard test and the 12-minute walk/run test, classified as fine and gross motor skills, respectively. Motor proficiency involved field goals and foul shots of the six players of the 1974-75 Washington Bullets professional basketball team with the most minutes played during the season. No significant relationships were obtained for the physical cycle and the gross motor performance and moter proficiency areas, although evidence was found within the fine

motor skills category generally to support biorhythm theory. While one must certainly guestion the use of only the physical cycle, rather than all three cycles, the consideration that biorhythms may primarily affect fine motor skills as opposed to gross motor skills is one that may be critical in future research efforts.

Motor performance was also used in research by Donnelly (1). One group of subjects was examined on motor performance measures in the laboratory, while actual performance measures in the field were obtained for members of the varsity swimming, rifle, and men's and women's gymnastics teams. Although there was some indication of a relationship between the intellectual cycle and performance, it was concluded the biorhythm theory was not supported as it related to human performance.

Belowich and Sachs (4) evaluated the relationship of biorhythms to the swimming performance of 21 subjects. Two scales were used to measure position on the three biorhythm cycles, and were compared with two types of performance evaluations: a coach's subjective evaluation of the swimmer's performance (on a rating scale of 1-7), and an objective performance evaluation consisting of average times for a set of 10 x 50 yard swims on a 45 second send-off. The results were not supportive of biorhythm theory.

Wright (68) reported that there are basically two different views of biorhythms, the most popular theory

is based only a person's birth date, while the other is based on times-series analysis (TSA) techniques. Wright developed a data collection method which involves the use of a rating scale for each of the physical, emotional, and mental variables. Each rating scale has numerical value ranging from one, the most negative response, to nine, the most positive response. The three rating scales were used each day to obtain a quantitative measure of an individual's relative physical, emotional, and mental states for that day. The data were collected daily for time periods ranging from 70 days to 1,275 days in 10 subjects. He found that physical, emotional, and mental cycle lengths ranging from 2 days to 54 days. Biorhythms determined by TSA were found to be correlated with athletic or physical fitness events, but no significant correlation was found between sport performance and the biorhythms determined from one's birth date.

Biorhythm and Athletic Injuries

According to biorhythm theory, an individual will be more vulnerable to having physical problems and accidents on critical days. Biorhythmic studies associated with the frequency of injuries and accidents have been reported. Gittelson (19) collected injury information on the 1972 Missouri Southern State football team. She reported that of the 13 injuries which occurred during the season, 69

percent occurred on critical days. This figure was substantially greater than the 20.4 percent that would occur on critical days by chance.

Martin et al (41) examined a total of 159 athletic injuries data which incurred during the 1977 Spring athletic season at Brockport State College. Biorhythm data were calculated for each individual for the day of injury in order to determine if the injury had in fact occurred on a critical day. A lack of relationship between athletic injuries and biorhythmic critical days was reported. Warren and Lanning (64) analyzed a total of 199 football injuries in their study. Two definitions were used for critical days. Definition A is more conservative and defines a critical day as the first day of any cycle and the mid-point day of any cycle. Definition B includes all of the critical days in definition A, but also includes the days before and after each of the critical days in definition A. No significant relationship existed between the occurrence of a football injury and biorhythmic critical day of the injured player.

Johnson (27) attempted to determine a relationship between biorhythm cycles and football injuries. He concluded from his findings that there was no relationship between the emotional and intellectual rhythms and the occurrence of football injuries, but a possible relationship appeared between the physical rhythm and incidence

of injury.

Jun (28) evaluated the relationship between biorhythms and injuries to college football participants representing Oregon State University. The population consisted of 192 players who participated in the intercollegiate football seasons of 1981 and 1982. No significant relationship was found between the critical days of the biorhythm of individual players and the occurrence of football injuries.

Summary

A review of related literature revealed that there is a great amount of controversy over the validity of the biorhythm theory. Proponents believe that there are numerous and invisible rhythms underlying the patterns of life within mankind which would subtly dictate how man behaves, performs and feels (45,40,54).

The application of biorhythms to athletic performance have met with reported success early in the 1970's, but has been recently considered to be without reliability. Scientific, controlled studies dealing with biorhythms and athletic injuries have produced results which suggest that the biorhythm theory must be considered with suspicion.

Injury studies related to biorhythms tend to focus on contact sports. Very few investigations have been reported which are associated with non-contact sports. Further exploration into the many facets of biorhythm theory is needed to fully determine the extent, if any, of cyclic influence upon different types of athletic injury.

CHAPTER III

PROCEDURES

This chapter describes the procedures employed in the collection and evaluation of the data, For clarification, the procedures are arranged according to the following areas:

1. Sample
2. Collection of data
3. Computation of biorhythms
   A. Definition of critical days
   B. Mathematical basis of biorhythms
   C. Computing and charting biorhythms

Sample

Injury data were collected from the injured fourteen female gymnasts of Oregon State University who were eligible for intercollegiate competition in accordance with rules established by the National Collegiate Athletic Association in the 1981 to 1984 seasons. From the fourteen women, a total of thirty injuries were recorded. Each of the women were in training for competition in all of the official events with the same coach.

Collection of Data

Injury data and birthdate data for this study were obtained from Ms. Betsy Slemmons, Oregon State University Assistant Athletic Trainer. Data were collected from 1981

to 1984, and as injuries occurred throughout each entire season from the first day of practice through the last competitive meet. The injuries included were only those acute injuries which occurred during practice or competition. Illness or any chronic(long term) injury was not to be included as an injury. Only those injuries were recorded which were severe enough such that the injured gymnasts had to be out of practice for regular training or to miss competition. Injuries incurred by subjects were included only if the injuries were new or if a sufficient time lapsed for old injuries to heal.

Computation of Biorhythms

Definition of critical days

There are several ways to define a critical day. Essentially, a day is "critical" when the probability of occurrence is highest and the probability of occurrence varies according to the number of days considered critical. For this study two definitions of the critical days were used to determine what days would be considered critical.

Definition A is most accepted in biorhythm publications. A critical day is defined as a 24 hour period (49). The date of birth is taken as a critical day. Since the precise moments of birth and of the event are not usually known, the best approximation is to take 12 noon

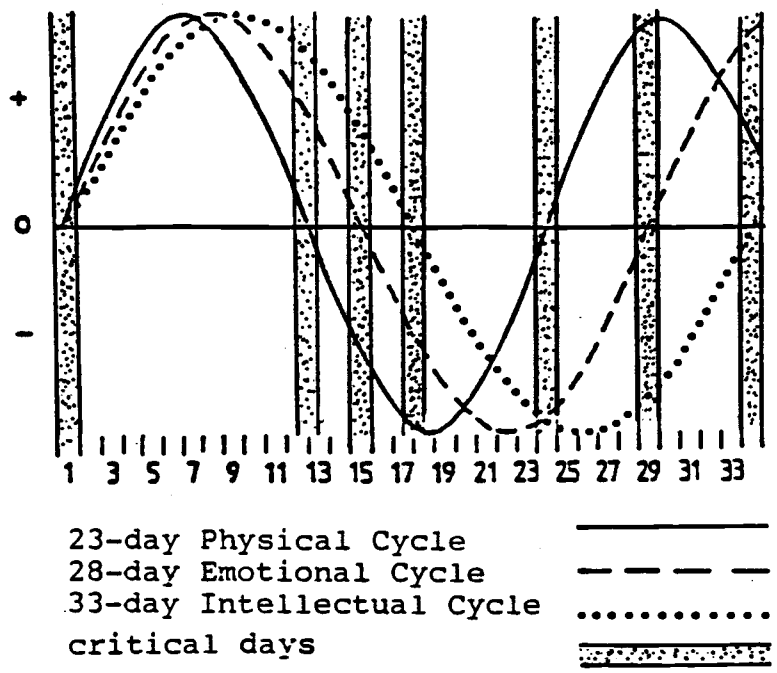
as the hour of birth. Day 1 in each cycle then becomes a critical day.

In the 28 day emotional cycle day 15 is the second critical day. However, in the physical and emotional cycle, the crossover point falls between two days and therefore the critical 24 hour period extends from 12 noon on the first to 12 noon on the second. In this analysis half the records occurring on each of these two days were considered to fall within the critical day and half outside it. Therefore in each cycle two days were considered critical and of the remainder half were in the positive phase and half were in the negative phase. These proportions yielded to expected frequencies for a random model.

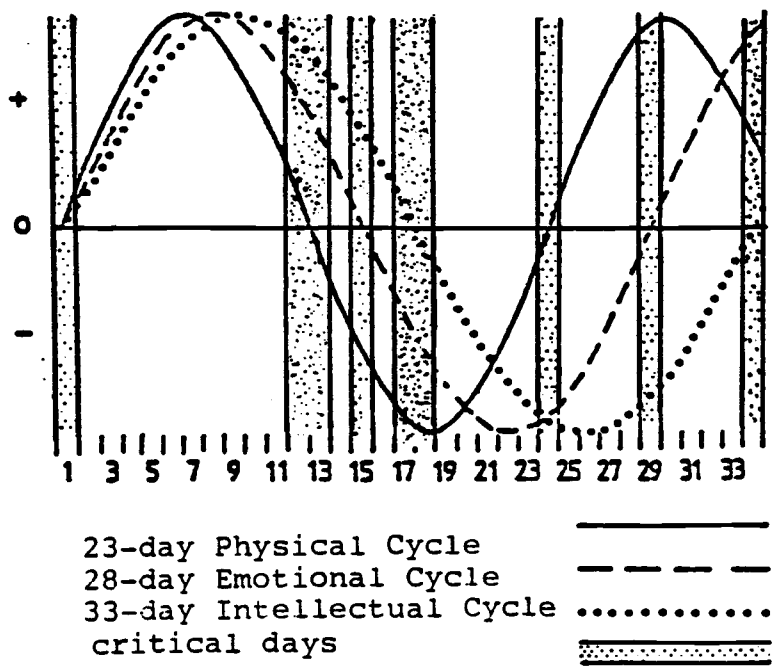
Definition B is more flexible. A critical day is defined either as the first day of any cycle or as the mid-point day of any cycle (64). Since, for the physical and intellectual cycles, there are an uneven number of days in cycle the mid-point includes two overlapping days. Therefore, the critical days for each of the cycles are: physical 1,12,13; emotional 1,15; intellectual 1,17,18 (Figure 3-1).

Definition A is the most commonly used definition in biorhythm publications(61). Definition B has also been included in this study because it has been most often used in the popular application of biorhythm theory(64).

The following information presents the formulas for



Definition A



Definition B

Figure 3-1 Comparison between Critical Days of Definition A and Critical Days of Definition B

computing the expected frequency of injuries as they were used in the analysis of this study(50).

Definition A

The random probabilities p(P) of an injury occurrence on a day that was critical in the physical cycle, but non-critical on the other two cycles is:

p(P)= p(P critical) x p(E non-critical) x p(I non-critical)

=(2/23)x(26/28)x(31/33)

=.0759

where p= probability, and

P= physical cycle

E= emotional cycle

I= intellectual cycle

The random probabilities p(E) of an injury occurrence on a day that was critical in the emotional cycle, but non-critical on the other two cycles is:

p(E)=p(P non-critical) x p(E critical) x p(I non-critical)

=(21/23)x(2/28)x(31/33)

=.0613

The random probabilities p(I) of an injury occurrence on a day that was critical in the intellectual cycle, but non-critical on the other two cycles is:

p(I)=p(P non-critical) x p(E non-critical) x p(I critical)

=(21/23)x(26/28)x(2/33)

=.0514

The random probabilities of an injury occurrence on

a day with more than one cycle in the critical phase is:

p(P+E)=(2/23)x(2/28)x(31/33)=.0058

p(P+I)=(2/23)x(26/28)x(2/33)=.0049

p(E+I)=(21/23)x(2/28)x(2/33)=.0040

p(P+E+I)=(2/23)x(2/28)x(2/33)=.0004

Definition B

p(P)=p(P critical) x p(E non-critical) x p(I non-critical)

=(3/23)x(26/28)x(30/33)

=.1101

p(E)=p(P non-critical) x p(E critical) x p(I non-critical)

=(20/23)x(2/28)x(30/33)

=.0565

p(I)=p(P non-critical) x p(E non-critical) x p(I critical)

=(20/23)x(26/28)x(3/33)

=.0734

p(P+E)=(3/23)x(2/28)x(30/33)

=.0110

p(E+I)=(20/23)x(2/28)x(3/33)

=.0056

p(P+E+I)=(3/23)x(2/28)x(3/33)

=.0008

The probabilities determined in both Definition A and Definition B for each of the eight mutually exclusive categories related to critical days are shown in Table 3-1.

Table 3-1

Random Probabilities of An Injury Occurring on A Day with Zero, One or More Than One Cycle in the Critical Phase

	Critical Phases	
	Zero or Single	Multiple
Def.A	p(0)=.7963 (non-critical)	p(P+E)=.0058
	p(P)=.0759	p(P+I)=.0049
	p(P)=.0613	p(E+I)=.0040
	p(I)=.0514	p(P+E+I)=.0004
Def.B	p(0)=.7341 (non-critical)	p(P+E)=.0085
	p(P)=.1101	p(P+I)=.0110
	p(E)=.0565	p(E+I)=.0056
	p(I)=.0734	p(P+E+I)=.0008

Mathematical Basis of Biorhythms

Bioryhthmic charting is a model based on mathematics of sinusoidal functions. To obtain the correct sinusoidal wave pattern the formula for sinusoidal wave is used(2), the basic rhythm, A, may be symbolized by a sine wave with period T: $A = \sin[\frac{2\pi}{T}(t+\phi)]$ (3.1)

where $2\pi = 360^{\circ}$

T= period in days

t= time in cycle days

ϕ= phase displacement

Consequently, individuals with different birth dates will have different composite biorhythm charts, even though the theory holds that the cycles of all individuals follow the same 23,28, and 33 day biorhythms. Three biorhythm cycles may be described at any point in time by the following relationship:

$$P = \sin[\, 2\pi/23\ (t+\phi_1)\,] \qquad (3.2)$$

$$E = \sin[\, 2\pi/28\ (t+\phi_2)\,] \qquad (3.3)$$

$$I = \sin[\, 2\pi/33\ (t+\phi_3)\,] \qquad (3.4)$$

where P = the physical cycle

ϕ_1 = physical phase displacement

E = emotional cycle

ϕ_2 = emotional phase displacement

I = intellectual cycle

ϕ_3 = intellectual phase displacement

To calculate a subject's biorhythm at any given time, it first requires that the date being recorded be specified. The subject's age in days from the date of birth, up to and including the date of injury, must next be determined. In the calculation, consideration should be given to regular leap years. The phase displacement may be calculated and employed in Equation (3.2),(3.3), (3.4):

$$\phi = (Y/CL - CC)$$

where ϕ = phase displacement, or day of the current biorhythm cycle on which the observed event occurred

Y= subject's age

CL= cycle length in days(23 days for physical, 28 days for emotional, 33 days for intellectual)

CC= whole number of completed cycles(whole number associated with Y/CL)

Figure 3-2 illustrates a typical biorhythm cycle at a specified point in time.

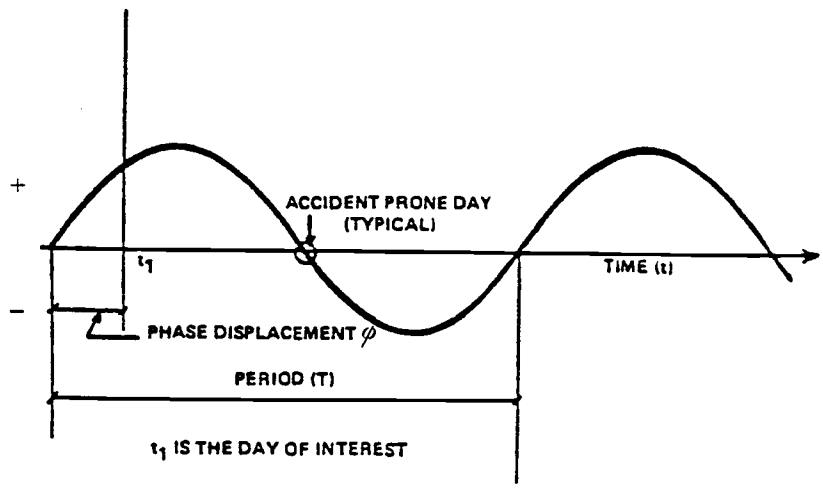


Figure 3-2 Typical Biorhythm Cycle

Computing and Charting Biorhythms

Although mathematical calculations can be used to obtain biorhythm chart values, it is also possible to obtain these values from tables found in Gittelson's Biorhythm Charts(21).

In order to assure accuracy, values used in this study were obtained using both methods.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to determine if athletic injuries of female college gymnasts were related to physical, emotional and/or intellectual biorhythm cycles. Data were collected from a sample of fourteen injured women gymnasts of Oregon State University over a period from 1981 to 1984. A total of thirty injuries were recorded during that period of time. Critical days were calculated for each of the individuals in accordance with two definitions of critical days.

Results

The incidence and the percentage of injuries which occurred during 1981 to 1984 is shown in Table 4-1.

Table 4-1

Injury Incidence and Percentage by Year

Year	1981	1982	1983	1984	Total
Number of Injuries	4	12	7	7	30
%	13.33	40.00	23.33	23.33	100

It may be seen that 1982 was the year when the most

injuries occured. 1983 and 1984 were the second years for injuries. These data are illustrated in Graph 4-1.

The incidence of injury by anatomical location is presented in Table 4-2.

Table 4-2

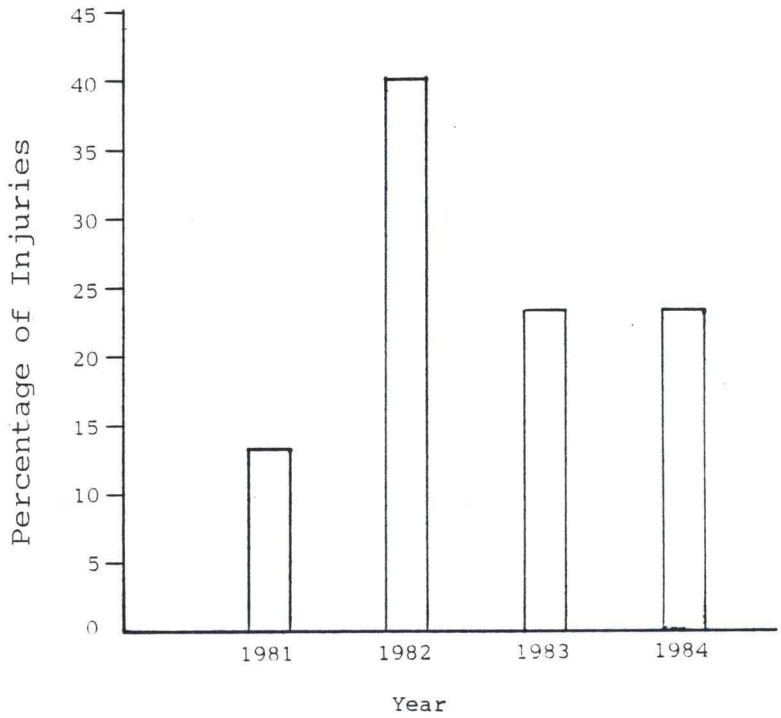
Injury Incidence and Percentage by Anatomical Location

Anatomical Location	Number of injuries	%
Shoulder Joint	2	6.67
Sternum	2	6.67
Lower Back	1	3.33
Elbow Joint	2	6.67
Finger	1	3.33
Quadriceps	1	3.33
Knee	7	23.33
Anterior Tibialis	2	6.67
Extensor Hallucis Longus	1	3.33
Soleus	1	3.33
Ankle	6	20.00
Foot	4	13.33
Total	30	100.00

The knee(23.33%) was the most frequent the site of injury. The ankle(20%) and the foot(13.33%) were the second and the third most common anatomical site of injury. These data are illustrated in Graph 4-2.

Graph 4-1

Injury Percentage by Year



Graph 4-2

Incidence of Injury by Anatomical Location

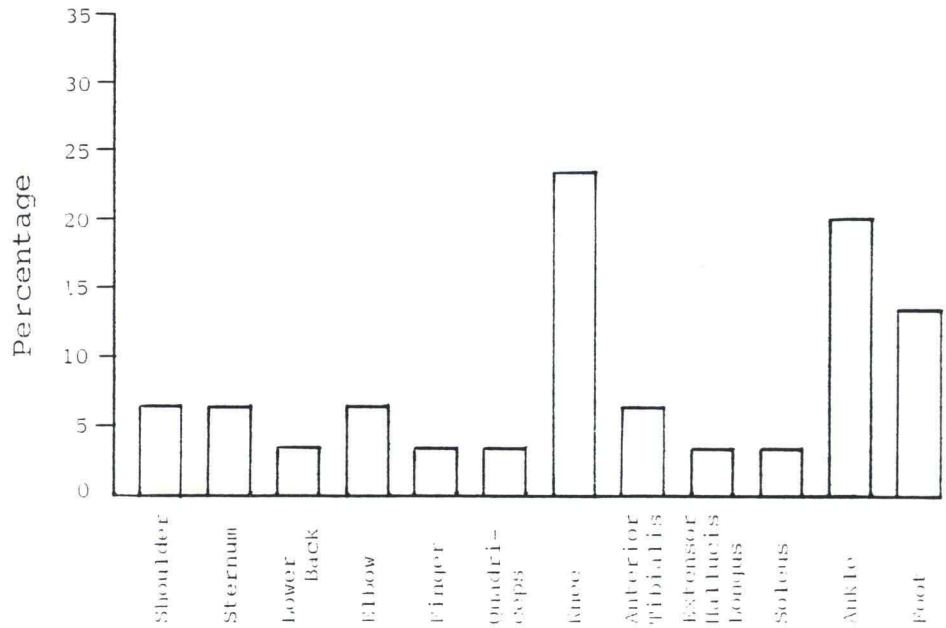


Table 4-3 shows the incidence of injury on critical days. It can be seen that the use of Definition A produced only three injuries on critical days. Use of Definition B, however, produced seven injuries on critical days.

Table 4-3

Injury Incidence of Critical Days

Critical	Injury Incidence Def. A	Def. B
Single Physical	0	2
Single Emotional	1	2
Single Intellectual	2	3
Double Critical (P+E)	0	0
Double Critical (E+I)	0	0
Double Critical (P+I)	0	0
Triple Critical (P+E+I)	0	0
Total	3	7

P = Physical
E = Emotional
I = Intellectual

Statistical Treatment

Data were statistically analyzed to test the hypothesis that no significant differences exist between the numbers of injuries and physical, emotional or intellectual

biorhythm phases. Owing to small cell values for expected frequencies, Chi-Square with Yates' correction for continuity(12) was applied to determine statistical significance at .05 level of confidence($\chi^2=\frac{(|\text{Observed-Expected}|-.5)^2}{\text{Expected}}$). Expected frequencies(random probabilities of injuries occurrence on crical days) were determined to compare them with the observed injury frequencies.

Table 4-4 and 4-5 below present the results of analyses with the Yates' corrections. Table 4-4 illustrates the Chi-Square statistical analysis of non-critical days and critical days.

Table 4-4

Chi-Square Analysis of Non-Critical Days and Critical Days

Cycle	Definition A Obs.	Exp.	Chi-Square	Definition B Obs.	Exp.	Chi-Square
Non-Critical	27	23.89	.29	23	22.02	.01
Single Critical	3	5.66	1.76	7	7.2	.07
Multiple Critical	0	.45	2.01	0	.78	2.1
			4.06			2.18

N = 30
α = .05
Tabular χ^2 = 5.99

The number of injuries that occurred on critical days is shown in Table 4-4. Because of their small numbers, double and triple critical days have been combined in a sin-

gle cell. The non-significance of injuries on critical days is proportional to the number of critical days, and therefore fits a random model. There is no evidence from the analysis of thirty gymnastic injuries to support the hypothesis that injuries are more frequent during critical days than at other times.

The observed and expected frequencies for injury incidence during positive, negative and critical phases of each individual cycle are shown in Table 4-5.

Table 4-5

Injury Incidence During Individual Cycle Phases

Cycle	Injuries Observed Def.A	Def.B	Injuries Expected Def.A	Def.B	Chi-Square Def.A	Def.B
Physical						
Positive	15	13	13.70	13.05	.05	.02
Negative	15	15	13.70	13.05	.05	.16
Critical	0	2	2.61	3.91	3.71	1.49
					3.81	1.67
Emotional						
Positive	17	16	13.93	13.93	.47	.18
Negative	12	12	13.93	13.93	.42	.42
Critical	1	2	2.15	2.14	1.27	.19
					2.16	.79
Intellectual						
Positive	11	10	14.09	13.64	.91	1.26
Negative	17	17	14.09	13.64	.41	.60
Critical	2	3	1.82	2.72	.06	.31
					1.38	2.17

N = 30
α = .05
Tabular χ^2 = 5.99

The non-significant Chi-Square indicates that injuries occurred randomly with respect to each cycle. The null

hypothesis was retained. There is no evidence in this study to support the hypothesis that injuries are more frequent during the negative phase of physical, emotional, and intellectual cycles.

Discussion

As noted in Table 4-4 and Table 4-5, all obtained Chi-Square values were less than 5.99, the value needed to establish significance of the .05 level with two degrees of freedom. In each instance the hypothesis testing rejected the null hypothesis. Therefore, the following statements are justified:

1. The number of injuries which occur on critical days is not more frequent than the number of injuries which occur on non-critical days.
2. The number of injuries is not more frequent during the negative phase of physical biorhythm cycle than during the positive phase.
3. The number of injuries is not more frequent during the negative phase of emotional biorhythm cycle than during the positive phase.
4. The number of injuries is not more frequent during the negative phase of intellectual cycle than during the positive phase.
5. The number of injuries is not more frequent during the negative phase than during the positive phase when the physical, emotional, and intellectual biorhythm cycles are

combined.

Biorhythm proponents (60,21) claimed that when an individual's biorhythm cycles are negative or critical, an increased probability of accident or human error result. If the theory is true, an individual will be more likely to have a gymnastic injury on a physical, emotional, and/or intellectual negative phases or critical days. However, this theory was not shown to be supported in the present study, even though the use of Definition B provided a much greater critical probability. Studies from Martin et al(41), Warren and Lanning(64), Johnson(27), Wood et al(67), and Jun(28) produced similar conclusions.

It was suggested(50) that if biorhythm studies are to be acceptable, they must be based on 1) objective measures of the event, 2) publicly accessible data, 3) all the events within a defined population, and 4) valid statistical analysis. Unfortunately, authors of most biorhythm books of the popular literature do not meet such qualifications. Most of the presumed evidence consists of a selection of specific events to support the biorhythm theory.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND SUGGESTIONS

Summary

The review of literature for this study revealed there is a great amount of controversy over the validity of the biorhythm theory. The biorhythm theory is consistent with observations of fundamental biological rhythms. Biological rhythms are basic, relevant and ever present physiological phenomena in human life and present in plants, animals, and humans. Biorhythm theory proponents believe that a human has 23-day physical, 28-day emotional and 33-day intellectual sinusoidal cycles.

The physical cycle relates to activities of a physical nature. The emotional cycle influences situations of high emotional content. The intellectual cycle takes on importance in performances which require cognitive activity.

When a cycle is in the positive portion of an oscillation, energy is considered to be discharged. Thus, performance potential is enhanced for those tasks related to this particular rhythm. When each cycle crosses the baseline from positive to negative, or vice versa, that point represents a critical day. During critical days, performance potential is considered highly unstable. It is

believed that incidents of human error are especially numerous on critical days.

The general problem specifically involved was to determine if gymnastic injuries are related to physical, emotional, and/or intellectual biorhythm cycles. More specifically, the problem was to determine the extent to which the positive, negative and critical phases of the three biorhythm cycles or their combinations contribute to gymnastic injuries. An additional effort was made to assess the incidence of gymnastic injuries by anatomical location. Data were collected from a sample of fourteen injured women gymnasts of Oregon State University over a period from 1981 to 1984. A total of thirty injuries were recorded during that period of time, and the knee injuries were the most common.

Critical days were calculated for each of the individuals in accordance with the two definitions by which critical days are identified. Definition A is most accepted in biorhythm publications. By definition A a critical day is defined as a 24 hour period of which 12 hours fall on each side of the point where the cycle passes from positive to negative. Definition B is more flexible. A critical day is defined as the first day of any cycle and/or as the midpoint day of any cycle. Therefore, under the definition B the critical days for each of the cycle are: physical 1,12, 13; emotional 1,15; intellectual 1,17,18.

The raw data were obtained both by using the Gittelson's biorhythm charting method and by mathematical calcu-

lation. Expected frequencies were determined to compare them with the observed injury frequencies. Chi-Square with Yates' correction for continuity was employed to determine the statistical significance at the .05 level of confidence.

Findings

In relation to the hypotheses stated in Chapter 1, the analysis of the data revealed the following:

1. Hypothesis Number 1

   The statistical analysis supported the null hypothesis. The number of injuries which occurred on critical days was not more frequent than the number of injuries which occurred on non-critical days.

2. Hypothesis Number 2

   The statistical analysis supported the null hypothesis. No differences exist between the number of injuries that occurred during the different phases of the physical biorhythm cycle.

3. Hypothesis Number 3

   The statistical analysis supported the null hypothesis. No differences exist between the number of injuries that occurred during the different phases of the emotional biorhythm cycle.

4. Hypothesis Number 4

   The statistical analysis supported the null hypothesis. No differences exist between the number of injuries that occurred during the different phases of

the intellectual biorhythm cycle.

5. Hypothesis Number 5

The statistical analysis supported the null hypothesis. No differences exist between the number of injuries that occurred during the different phases of the combination of physical, emotional, and intellectual biorhythm cycles.

Conclusions

Based upon the analysis of the data, the following conclusions were considered appropriate:

1. The data do not support the hypothesis that gymnastic injuries should be more frequent during critical days than on non-critical days.
2. The data do not support the hypothesis that gymnastic injuries should be more frequent during the negative phase of physical biorhythm cycle than during the positive phase.
3. The data do not support the hypothesis that gymnastic injuries should be more frequent during the negative phase of emotional biorhythm cycle than during the positive phase.
4. The data do not support the hypothesis that gymnastic injuries should be more frequent during the negative phase of intellectual biorhythm cycle than during the positive phase.
5. The data do not support the hypothesis that gymnastic injuries should be more frequent during the negative phase than they are during the positive phase when the

physical, emotional, and intellectual biorhythm cycles are combined.

In summary, The data of this study are in agreement with other studies (41,64,27,67,28) which do not support biorhythm theory. Consequently, attention to biorhythms would seem to be ineffective as a means of avoiding gymnastic (or other) injuries,(i.e., by remaining inactive during critical days).

Suggestions for Further Study

The results of this study suggest the following:

1. A similar study might be more meanningful if a sample were used for which the exact times of birth are known so that the biorhythm cycles and critical day periods could be precisely identified.
2. A similar study might be useful if one examined the influence of the various biorhythm cycles upon such physiological variables as reaction time, metabolic rate, and perceptual functions.

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APPENDICES

APPENDIX A

Biorhythm Position and Injury Anatomical Location of the Injured Gymnasts

Injuries	Birth Date	Injury Date	Biorhythm Def. A			Position Def. B			Anatomical Location
			P	E	I	P	E	I	
01	7-28-62	1-7-83	-	-	+	-	-	+	Knee
02	8-31-62	2-3-82	-	+	+	-	+	+	Elbow
03	9-21-59	10-20-81	+	+	-	+	+	-	Knee
04	9-21-59	12-10-81	-	-	-	-	-	-	Sternum
05	9-21-59	2-6-82	+	-	-	+	-	-	Knee
06	8-20-62	9-27-82	+	+	-	+	+	-	Quadriceps
07	8-20-62	2-2-82	-	-	+	-	-	+	Foot
08	8-20-62	2-6-82	+	-	+	+	-	0	Ankle
09	8-20-62	3-19-82	-	+	-	-	+	-	Ankle
10	12-25-61	10-6-81	-	+	-	-	+	-	Lower Leg
11	12-25-61	1-21-81	-	-	+	-	-	+	Metatarsals
12	12-25-61	3-2-82	-	+	+	-	+	+	Foot
13	12-25-61	3-1-84	+	+	-	+	+	-	Shoulder
14	1-18-63	12-7-82	-	+	+	-	+	+	Knee
15	1-18-63	3-1-84	+	+	-	+	0	-	Finger
16	3-12-63	2-28-82	+	+	-	+	+	-	Ankle
17	3-12-63	5-8-82	+	-	+	+	-	+	Knee
18	8-15-63	1-15-82	-	+	-	-	+	-	Lower Leg (Tibialis)
19	8-15-63	9-19-83	+	+	+	+	+	+	Knee
20	8-15-63	1-11-83	+	+	-	+	+	-	Lower leg (Soleus)
21	8-15-63	3-26-83	+	-	+	0	-	+	Knee

Injuries	Birth Date	Injury Date	Biorhythm Def. A P	E	I	Position Def. B P	E	I	Anatomical Location
22	8-15-63	2-10-84	+	+	-	+	+	-	Foot
23	8-12 64	2-10-84	-	+	-	-	+	-	Ankle
24	3-6-64	11-10-83	-	-	0	-	-	0	Elbow
25	10-8-64	12-30-82	+	-	-	0	-	-	Ankle
26	7-5-62	1-19-84	+	0	+	+	0	+	Shoulder
27	7-13-61	2-29-84	+	+	0	+	+	0	Sternum
28	7-13-61	1-4-84	-	+	-	-	+	-	Shoulder
29	7-13-61	10-3-83	-	-	-	-	-	-	Lower Back
30	12-1-65	10-10-83	-	-	-	-	-	-	Knee

APPENDIX B

Birth Charts

1962

...JANUARY..		..FEBRUARY..		....MARCH...		....APRIL...		.....MAY....		....JUNE....	
	P--E--I		P--E--I		P--E--I		P--E--I		P--E--I		P--E--I
1)	D..J..V	1)	M..M..T	1)	R..M..O	1)	B..P..M	1)	J..R..J	1)	R..U..G
2)	E..K..W	2)	N..N..U	2)	S..N..P	2)	C..Q..N	2)	K..S..K	2)	S..V..H
3)	F..L..X	3)	O..O..V	3)	T..O..Q	3)	D..R..O	3)	L..T..L	3)	T..W..J
4)	G..M..Y	4)	P..P..W	4)	U..P..R	4)	E..S..P	4)	M..U..M	4)	U..X..K
5)	H..N..Z	5)	Q..Q..X	5)	V..Q..S	5)	F..T..Q	5)	N..V..N	5)	V..Y..L
6)	J..O..1	6)	R..R..Y	6)	W..R..T	6)	G..U..R	6)	O..W..O	6)	W..Z..M
7)	K..P..2	7)	S..S..Z	7)	X..S..U	7)	H..V..S	7)	P..X..P	7)	X..1..N
8)	L..Q..3	8)	T..T..1	8)	A..T..V	8)	J..W..T	8)	Q..Y..Q	8)	A..2..O
9)	M..R..4	9)	U..U..2	9)	B..U..W	9)	K..X..U	9)	R..Z..R	9)	B..3..P
10)	N..S..5	10)	V..V..3	10)	C..V..X	10)	L..Y..V	10)	S..1..S	10)	C..A..Q
11)	O..T..6	11)	W..W..4	11)	D..W..Y	11)	M..Z..W	11)	T..2..T	11)	D..B..R
12)	P..U..7	12)	X..X..5	12)	E..X..Z	12)	N..1..X	12)	U..3..U	12)	E..C..S
13)	Q..V..8	13)	A..Y..6	13)	F..Y..1	13)	O..2..Y	13)	V..A..V	13)	F..D..T
14)	R..W..A	14)	B..Z..7	14)	G..Z..2	14)	P..3..Z	14)	W..B..W	14)	G..E..U
15)	S..X..B	15)	C..1..8	15)	H..1..3	15)	Q..A..1	15)	X..C..X	15)	H..F..V
16)	T..Y..C	16)	D..2..A	16)	J..2..4	16)	R..B..2	16)	A..D..Y	16)	J..G..W
17)	U..Z..D	17)	E..3..B	17)	K..3..5	17)	S..C..3	17)	B..E..Z	17)	K..H..X
18)	V..1..E	18)	F..A..C	18)	L..A..6	18)	T..D..4	18)	C..F..1	18)	L..I..Y
19)	W..2..F	19)	G..B..D	19)	M..B..7	19)	U..E..5	19)	D..G..2	19)	M..K..Z
20)	X..3..G	20)	H..C..E	20)	N..C..8	20)	V..F..6	20)	E..H..3	20)	N..L..1
21)	A..A..H	21)	J..D..F	21)	O..D..A	21)	W..G..7	21)	F..I..4	21)	O..M..2
22)	B..B..J	22)	K..E..G	22)	P..E..B	22)	X..H..8	22)	G..K..5	22)	P..N..3
23)	C..C..K	23)	L..F..H	23)	Q..F..C	23)	A..J..A	23)	H..L..6	23)	Q..O..4
24)	D..D..L	24)	M..G..J	24)	R..G..D	24)	B..K..B	24)	I..M..7	24)	R..P..5
25)	E..E..M	25)	N..H..K	25)	S..H..E	25)	C..L..C	25)	K..N..8	25)	S..Q..6
26)	F..F..N	26)	O..J..L	26)	T..J..F	26)	D..M..D	26)	L..O..A	26)	T..R..7
27)	G..G..O	27)	P..K..M	27)	U..K..G	27)	E..N..E	27)	M..P..B	27)	U..S..8
28)	H..H..P	28)	Q..L..N	28)	V..L..H	28)	F..O..F	28)	N..Q..C	28)	V..T..A
29)	J..J..Q			29)	W..M..J	29)	G..P..G	29)	O..R..D	29)	W..U..B
30)	K..K..R			30)	X..N..K	30)	H..Q..H	30)	P..S..E	30)	X..V..C
31)	L..L..S			31)	A..O..L			31)	Q..T..F		

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.....JULY....		...AUGUST...		..SEPTEMBER.		..OCTOBER...		..NOVEMBER..		..DECEMBER..	
	P--E--I		P--E--I		P--E--I		P--E--I		P--E--I		P--E--I
1)	A..W..D	1)	J..Z..B	1)	R..3..8	1)	A..B..5	1)	J..E..3	1)	Q..G..Z
2)	B..X..E	2)	K..1..C	2)	S..A..A	2)	B..C..6	2)	K..F..4	2)	R..H..1
3)	C..Y..F	3)	L..2..D	3)	T..B..B	3)	C..D..7	3)	L..G..5	3)	S..J..2
4)	D..Z..G	4)	M..3..E	4)	U..C..C	4)	D..E..8	4)	M..H..6	4)	T..K..3
5)	E..1..H	5)	N..A..F	5)	V..D..D	5)	E..F..A	5)	N..I..7	5)	U..L..4
6)	F..2..I	6)	O..B..G	6)	W..E..E	6)	F..G..B	6)	O..K..8	6)	V..M..5
7)	G..3..X	7)	P..C..H	7)	X..F..F	7)	G..H..C	7)	P..L..A	7)	W..N..6
8)	H..A..L	8)	Q..D..J	8)	A..G..G	8)	H..J..D	8)	Q..M..B	8)	X..O..7
9)	J..B..M	9)	R..E..K	9)	B..H..H	9)	J..K..E	9)	R..N..C	9)	A..P..8
10)	K..C..N	10)	S..F..L	10)	C..J..J	10)	K..L..F	10)	S..O..D	10)	B..Q..A
11)	L..D..O	11)	T..G..M	11)	D..K..K	11)	L..M..G	11)	T..P..E	11)	C..R..B
12)	M..E..P	12)	U..H..N	12)	E..L..L	12)	M..N..H	12)	U..Q..F	12)	D..S..C
13)	N..F..Q	13)	V..I..O	13)	F..M..M	13)	N..O..I	13)	V..R..G	13)	E..T..D
14)	O..G..R	14)	W..K..P	14)	G..N..N	14)	O..P..K	14)	W..S..H	14)	F..U..E
15)	P..H..S	15)	X..L..Q	15)	H..O..O	15)	P..Q..L	15)	X..T..I	15)	G..V..F
16)	Q..J..T	16)	A..M..R	16)	J..P..P	16)	Q..R..M	16)	A..U..K	16)	H..W..G
17)	R..K..U	17)	B..N..S	17)	K..Q..Q	17)	R..S..N	17)	B..V..L	17)	J..X..H
18)	S..L..V	18)	C..O..T	18)	L..R..R	18)	S..T..O	18)	C..W..M	18)	K..Y..J
19)	T..M..W	19)	D..P..U	19)	M..S..S	19)	T..U..P	19)	D..X..N	19)	L..Z..K
20)	U..N..X	20)	E..Q..V	20)	N..T..T	20)	U..V..Q	20)	E..Y..O	20)	M..1..L
21)	V..O..Y	21)	F..R..W	21)	O..U..U	21)	V..W..R	21)	F..Z..P	21)	N..2..M
22)	W..P..Z	22)	G..S..X	22)	P..V..V	22)	W..X..S	22)	G..1..Q	22)	O..3..N
23)	X..Q..1	23)	H..T..Y	23)	Q..W..W	23)	X..Y..T	23)	H..2..R	23)	P..A..O
24)	A..R..2	24)	J..U..Z	24)	R..X..X	24)	A..Z..U	24)	J..3..S	24)	Q..B..P
25)	B..S..3	25)	K..V..1	25)	S..Y..Y	25)	B..1..V	25)	K..A..T	25)	R..C..Q
26)	C..T..4	26)	L..W..2	26)	T..Z..Z	26)	C..2..W	26)	L..B..U	26)	S..D..R
27)	D..U..5	27)	M..X..3	27)	U..1..1	27)	D..3..X	27)	M..C..V	27)	T..E..S
28)	E..V..6	28)	N..Y..4	28)	V..2..2	28)	E..A..Y	28)	N..D..W	28)	U..F..T
29)	F..W..7	29)	O..Z..5	29)	W..3..3	29)	F..B..Z	29)	O..E..X	29)	V..G..U
30)	G..X..8	30)	P..1..6	30)	X..A..4	30)	G..C..1	30)	P..F..Y	30)	W..H..V
31)	H..Y..A	31)	Q..2..7			31)	H..D..2			31)	X..J..W

CODES: P-PHYSICAL BIORHYTHM CURVE,E-EMOTIONAL BIORHYTHM CURVE,I-INTELLECTUAL BIORHYTHM CURVE

From Gittelson B. Biorhythm: A Personal Science. 320-321,1978.

APPENDIX C

Biorhythm Charts

JANUARY 1983 — **PHYSICAL**

1 SA	2 SU	3 M	4 TU	5 W	6 TH	7 F	8 SA	9 SU	10 M	11 TU	12 W	13 TH	14 F	15 SA
KJ	LK	ML	NM	ON	PO	QP	RQ	SR	TS	UT	VU	WV	XW	AX
LI	MJ	NK	OL	PM	QN	RO	SP	TQ	UR	VS	WT	XU	AV	BW
MG	NH	OJ	PK	QL	RM	SN	TO	UP	VQ	WR	XS	AT	BU	CV
NF	OG	PH	QJ	RK	SL	TM	UN	VO	WP	XQ	AR	BS	CT	DU
OE	PF	QG	RH	SJ	TK	UL	VM	WN	XO	AP	BQ	CR	DS	ET
PD	QE	RF	SG	TH	UJ	VK	WL	XM	AN	BO	CP	DQ	ER	FS
QC	RD	SE	TF	UG	VH	WJ	XK	AL	BM	CN	DO	EP	FQ	GR
RB	SC	TD	UE	VF	WG	XH	AJ	BK	CL	DM	EN	FO	GP	HQ
SA	TB	UC	VD	WE	XF	AG	BH	CJ	DK	EL	FM	GN	HO	JP
TX	UA	VB	WC	XD	AE	BF	CG	DH	EJ	FK	GL	HM	JN	KO
UW	VX	WA	XB	AC	BD	CE	DF	EG	FH	GJ	HK	JL	KM	LN
V	W	X	A	B	C	D	E	F	G	H	J	K	L	M

16 SU	17 M	18 TU	19 W	20 TH	21 F	22 SA	23 SU	24 M	25 TU	26 W	27 TH	28 F	29 SA	30 SU	31 M
BA	CB	DC	ED	FE	GF	HG	JH	KJ	LK	ML	NM	ON	PO	QP	RQ
CK	DA	EB	FC	GD	HE	JF	KG	LH	MJ	NK	OL	PM	QN	RO	SP
DW	EK	FA	GB	HC	JD	KE	LF	MG	NH	OJ	PK	QL	RM	SN	TO
EV	FW	GX	HA	JB	KC	LD	ME	NF	OG	PH	QJ	RK	SL	TM	UN
FU	GV	HW	JX	KA	LB	MC	ND	OE	PF	QG	RH	SJ	TK	UL	VM
GT	HU	JV	KW	LX	MA	NB	OC	PD	QE	RF	SG	TH	UJ	VK	WL
HS	JT	KU	LV	MW	NX	OA	PB	QC	RD	SE	TF	UG	VH	WJ	XK
JR	KS	LT	MU	NV	OW	PX	QA	RB	SC	TD	UE	VF	WG	XH	AJ
KQ	LR	MS	NT	OU	PV	QW	RX	SA	TB	UC	VD	WE	XF	AG	BH
LP	MQ	NR	OS	PT	QU	RV	SW	TX	UA	VB	WC	XD	AE	BF	CG
MO	NP	OQ	PR	QS	RT	SU	TV	UW	VX	WA	XB	AC	BD	CE	DF
N	O	P	Q	R	S	T	U	V	W	X	A	B	C	D	E

JANUARY 1983 — **EMOTIONAL**

1 SA	2 SU	3 M	4 TU	5 W	6 TH	7 F	8 SA	9 SU	10 M	11 TU	12 W	13 TH	14 F	15 SA
3	A	B	C	D	E	F	G	H	J	K	L	M	N	O
A2	B3	CA	DB	EC	FD	GE	HF	JG	KH	LJ	MK	NL	OM	PN
B1	C2	D3	EA	FB	GC	HD	JE	KF	LG	MH	NJ	OK	PL	QM
CZ	D1	E2	F3	GA	HB	JC	KD	LE	MF	NG	OH	PJ	QK	RL
DY	EZ	F1	G2	H3	JA	KB	LC	MD	NE	OF	PG	QH	RJ	SK
EX	FY	GZ	H1	I2	K3	LA	MB	NC	OD	PE	QF	RG	SH	TJ
FW	GX	HY	IZ	K1	L2	M3	NA	OB	PC	QD	RE	SF	TG	UH
GV	HW	IX	KY	LZ	M1	N2	O3	PA	QB	RC	SD	TE	UF	VG
HU	JV	KW	LX	MY	NZ	O1	P2	Q3	RA	SB	TC	UD	VE	WF
JT	KU	LV	MW	NX	OY	PZ	Q1	R2	S3	TA	UB	VC	WD	XE
KS	LT	MU	NV	OW	PX	QY	RZ	S1	T2	U3	VA	WB	XC	YD
LR	MS	NT	OU	PV	QW	RX	SY	TZ	U1	V2	W3	XA	YB	ZC
MQ	NR	OS	PT	QU	RV	SW	TX	UY	VZ	W1	X2	Y3	ZA	1B
NP	OQ	PR	QS	RT	SU	TV	UW	VX	WY	XZ	Y1	Z2	13	2A
O	P	Q	R	S	T	U	V	W	X	Y	Z	1	2	3

16 SU	17 M	18 TU	19 W	20 TH	21 F	22 SA	23 SU	24 M	25 TU	26 W	27 TH	28 F	29 SA	30 SU	31 M
P	Q	R	S	T	U	V	W	X	Y	Z	1	2	3	A	B
QQ	RP	SQ	TR	US	VT	WU	XV	YW	ZX	1Y	2Z	31	A2	B3	CA
RN	SO	TP	UQ	VR	WS	XT	YU	ZV	1W	2X	3Y	AZ	B1	C2	D3
SM	TN	UO	VP	WQ	XR	YS	ZT	1U	2V	3W	AX	BY	CZ	D1	E2
TL	UM	VN	WO	XP	YQ	ZR	1S	2T	3U	AV	BW	CX	DY	EZ	F1
UK	VL	WM	XN	YO	ZP	1Q	2R	3S	AT	BU	CV	DW	EX	FY	GZ
VJ	WK	XL	YM	ZN	1O	2P	3Q	AR	BS	CT	DU	EV	FW	GX	HY
WH	XJ	YK	ZL	1M	2N	3O	AP	BQ	CR	DS	ET	FU	GV	HW	IX
XG	YH	ZJ	1K	2L	3M	AN	BO	CP	DQ	ER	FS	GT	HU	IV	JW
YF	ZG	1H	2J	3K	AL	BM	CN	DO	EP	FQ	GR	HS	IT	JU	KV
ZE	1F	2G	3H	AJ	BK	CL	DM	EN	FO	GP	HQ	IR	JS	KT	LU
1D	2E	3F	AG	BH	CJ	DK	EL	FM	GN	HO	IP	JQ	KR	LS	MT
2C	3D	AE	BF	CG	DH	EJ	FK	GL	HM	JN	KO	LP	MQ	NR	OS
3B	AC	BD	CE	DF	EG	FH	GJ	HK	JL	KM	LN	MO	NP	OQ	PR
A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q

JANUARY 1983 — **INTELLECTUAL**

1 SA	2 SU	3 M	4 TU	5 W	6 TH	7 F	8 SA	9 SU	10 M	11 TU	12 W	13 TH	14 F	15 SA
2	3	4	5	6	7	8	A	B	C	D	E	F	G	H
1J	42	53	64	75	86	A7	B8	CA	DB	EC	FD	GE	HF	JG
4Z	51	62	73	R4	A5	B6	C7	D8	EA	FB	GC	HD	JE	KF
5Y	6Z	71	82	A3	B4	C5	D6	E7	FB	GA	HB	JC	KD	LE
64	7Y	8Z	A1	B2	C3	D4	E5	F6	G7	HB	JA	KB	LC	MD
7W	8X	AY	BZ	C1	D2	E3	F4	G5	H6	J7	KB	LA	MB	NC
RV	AW	BX	CY	DZ	E1	F2	G3	H4	J5	K6	L7	MB	NA	OB
AU	BV	CW	DX	EY	FZ	G1	H2	J3	K4	L5	M5	N7	OB	PA
BT	CU	DV	EW	FX	GY	HZ	J1	K2	L3	M4	N5	O6	P7	QB
C5	DT	EU	FV	GW	HX	JY	KZ	L1	M2	N3	O4	P5	Q6	R7
DR	ES	FT	GU	HV	JW	KX	LY	MZ	N1	O2	P3	Q4	R5	S6
EQ	FR	GS	HT	JU	KV	LW	MX	NY	O2	P1	Q2	R3	S4	T5
FP	GQ	HR	JS	KT	LU	MV	NW	OX	PY	QZ	R1	S2	T3	U4
GO	HP	JQ	KR	LS	MT	NU	OV	PW	QX	RY	SZ	T1	U2	V3
HN	JO	KP	LQ	MR	NS	OT	PU	QV	RW	SX	TY	UZ	V1	W2
JM	KN	LO	MP	NQ	OR	PS	QT	RU	SV	TW	UX	VY	WZ	X1
LL	MM	NN	OO	PP	QQ	RR	SS	TT	UV	VW	WX	XY	YZ	Z0

From Gittelson B. Biorhythm: A Personal Science. 392-393, 1978.