THE RELATIONSHIP OF THE 23-DAY PHYSICAL AND THE 28-DAY EMOTIONAL BIORHYTHM CYCLES TO FREE THROW ACCURACY

By

HAROLD WEISBEIN, SR.

Bachelor of Science in Health Education
West Chester State College
West Chester, Pennsylvania
1957

Master of Science
Ohio University
Athens, Ohio
1962

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
December, 1980

THE RELATIONSHIP OF THE 23-DAY PHYSICAL AND

THE 28-DAY EMOTIONAL BIORHYTHM CYCLES

TO FREE THROW ACCURACY

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

ACKNOWLEDGMENTS

I am sincerely appreciative to Dr. Aix B. Harrison, Professor, Health, Physical Education and Leisure Services and to Dr. O. D. Wikoff, Assistant Professor, Health, Physical Education and Leisure Services, for their guidance and assistance in the preparation of this manuscript. I would also extend a sincere thank you to the other members of my committee for their positive efforts on my behalf. They are: Dr. Thomas A. Karman, Professor and Head of Education Administration and Higher Education; Dr. Betty Abercrombie, Professor of Health, Physical Education and Leisure Services; and Dr. John G. Bayless, Professor of Health, Physical Education and Leisure Services.

Special thanks are extended to the Oklahoma State University Library personnel for services rendered and to the University of Science and Arts of Oklahoma Library personnel for securing information through the interlibrary loan system. A special thanks to members of the USAO English faculty for their professional critique of this manuscript. A special thank you to Dr. Bonnie Pride, Professor of Mathematics at USAO, for the development of the computer programs for this study and for assisting in the interpretation of the results.

Finally, I would express a special appreciation to my wife Margaret and to my children, Harold, Jr., Karen Sue, and Pamela Jeane, for their tolerance, understanding, and support which were so vitally necessary in the pursuit and completion of this degree.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

In recent years, there has been a revival of interest in human biological cycles and a considerable amount of research has been completed concerning various rhythmic functions within the human body. A great deal of information has been previously documented on short term cycles which are 24 to 36 hours in duration and which dealt with topics such as sleep and body temperature. These cycles were referred to as circadian rhythms (1, 5, 13, 15, 17, 19, 20, 22). Some research and limited documentation have been completed on rhythms of longer duration, and biorhythm cycles was included in this area of investigation.

The word "biorhythm" is derived from the Greek words "bios" meaning "life" and "rhythmos" referring to "measured motions" (4). There are believed to be three rhythms included in this cyclic pattern, and they are separated into an overlapping 23-day physical cycle, a 28-day emotional cycle, and a 33-day intellectual cycle (4). It is thought that each cycle begins at birth and is renewed with the completion of each 23-, 28-, and 33-day period respectively (4).

In reference to the three biorhythm cycles, people are said to experience critical days at the start, middle, and end of each cycle. These are days when the faculty in question -- physical, emotional, intellectual, or perhaps some combination -- is supposed to be the least reliable, exposing the individual to potential embarrassment,

and perhaps even danger. At the other extreme, when the three cycles peak on the same day, the individual should be capable of functioning with a high level of efficiency (18).

There are different opinions concerning the acceptance of the position of biorhythms in the fields of science and medicine. Bigham (3) stated that in reference to the 33-day cycle, writing and preparing manuscripts were affected by the intellectual cycle. This included researching a topic, taking and organizing notes, and preparing outlines.

Bolch (4) indicated that people at high points of these cycles have greater potential for high performance and at low points are likely to do more poorly. On critical days, when the curve crosses the neutral line, a person may have difficulty completing tasks that are normally considered routine.

Chan (7) commented that stressful situations could not be arranged to be particularly suitable to a person's biological clock. However, being aware of the various cycles allowed someone to be more alert on critical days and to utilize the time in a purposeful way.

Research suggests that there is increasing evidence of rhythms in many biological processes. Investigations "suggest the idea that both males and females have cycles in moods, which are associated with certain biological rhythms" (27, p. 82). Although there appears to be some scientific truth in reference to this information, "current research efforts have been minimal because of the massive methodological and conceptual problems of isolating the causes, biological and environmental, of the various cycles" (27, p. 82).

Parlee (27) commented on research concerning mood variations of men that was completed in 1931 by Hersey. Industrial workers were

interviewed while they were working. The interviews took place four times daily for an entire year. An assessment of their emotional state was determined each day by self-ratings, co-workers opinions, and his observations. The data that was graphed each week indicated definite mood cycles for every man. These cycles varied from 3.5 to 9 weeks in length, and were regular and predictable for each worker.

More support was provided in a report that indicated that the culture in the western hemisphere disregarded the importance of harmony and understanding concerning social and biological rhythms. Luce (27) observed that "factories ignore biological rhythms when workers are forced to change shifts" (p. 82). These new schedules did not take into account changes in body rhythms that make workers more effective at certain times.

A systematically prepared report supporting the rhythm cycles and their effects classified people into three groups: "people with illness recurring every 7 to 14 days, those with cycles of 21 to 23 days, and those with cycles of 28 to 30 days" (27, p. 85).

> The diurnal pattern of light and darkness, the seasons, the waxing and waning of the moon -- all seem to shape our experience in profound ways. Social norms such as work hours, mealtimes, holiday schedules, influence our bodies and performances (27, p. 82).

It was this removal from external cues or being exposed to other forms of cultures that immediately identified (in the case of social norms) the methods within which our experiences have been organized in a cyclical manner (27).

Research completed with baseball pitchers indicated that there was a relationship between top performance and high physical days. On the basis of 229 winning days for women golfers, 143 winning days for

men golfers, and 95 no-hit games for baseball pitchers, the percentage of these successes that coincided with a physical high day was no greater than that which would be expected by chance (9).

Nelson (25) stated that it is impossible to predict critical days. The idea that we have natural internal cycles was valid; however, there was no evidence to indicate that they could be predicted from a birthdate. Mackenzie (21) commented that biorhythms is a theory of apparent relationships between life's cycles and the physical, emotional, and intellectual state of humans. This theory still has not been scientifically proven.

If future research concerning these biological cycles provides tangible evidence of an effect on humans to perform routine tasks, the entire field of athletics may consider altering methods of training and preparing for athletic competition. Under certain circumstances biorhythm patterns may determine who does and who does not participate on a given day of competition.

Statement of the Problem

The purpose of this study was to determine whether the 23-day physical cycle and 28-day emotional cycle had a relationship to the success of free throw shooting for selected college and university male basketball players under game conditions when these factors were unknown to the players.

Significance of the Studies

Are there underlying factors affecting human behavior and performance that may remain beyond an individual's control? If this concept is validated, it would have a definite effect on human involvement in various activities that would include, among others, the world of sports participation. If biorhythms affect performance, then a coach would have an edge knowing which of two players, having fairly equal ability, would be most apt to perform better.

Hypothesis

There was no significant relationship between successful free throw shooting and the 23-day physical phase and the 28-day emotional phase of the biorhythm cycles.

Limitations

1. No attempt was made to determine the exact time of birth of the selected basketball players.

2. No attempt was made to play an individual basketball player on the basis of his biorhythm cycle.

Delimitations

1. This study was limited to selected college and university male basketball players from the 1977-78 basketball season.

2. The study was limited to the 23-day physical and the 28-day emotional cycles.

3. Only foul shots were used to measure physical skill.

4. The following institutions provided basketball statistics from the 1977-78 season: The University of Science and Arts of Oklahoma, Oklahoma Christian College, Bethany Nazarene College, Southwestern State University, Southeastern State University, Phillips University, Evangel College, Ouachita Baptist University, Midwestern University, Bartlesville Wesleyan College, and Oklahoma Baptist University.

Assumptions

1. That the official score books were accurate and complete.
2. That the birthdates of the players were correct.
3. That the player's health did not hinder his ability on game nights.
4. That the production of the biorhythm charts was correct.

Definition of Terms

1. Biorhythms: derived from the Greek words "bios" meaning life and "rhythmos" referring to measured motion (4).
2. Biorhythmic chart: a visual sine-curve chart indicating the status of the biorhythm cycles. This chart contains the days of the month and enables one to show the position of the cycles on a daily basis. On either side of the zero line are the plus and minus phases with the top half being the positive and discharge phase while the bottom half is the minus and recharge phase (28).
3. Zero line: This line indicates that a cycle is changing from one phase to another (28).
4. Critical day: This is a 24-hour period when the person is in an unstable state noted by the sine-curve crossing the zero line (28).

5. Discharge phase: The first half of the cycle when the person is in a positive stage and reportedly indicating high performance (30).

6. Recharge phase: The person is in a low phase and reportedly subject to poor performance (28).

7. Phase: Some part of a rhythm or cycle (28).

8. 23-day Physical Cycle: This cycle originates in the muscular cells and affects physical factors such as strength, speed, coordination, resistance to disease, and the sensation of physical well-being (10).

9. 28-day Emotional Cycle: The cycle is involved with the nervous system and governs mood, perceptions of the world, creativity, sensitivity, mental health, and to some degree, the sex of children conceived during different phases of the cycle (10).

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Are there underlying biological rhythms that affect the various levels of human emotions and motor performance? Do these rhythms remain beyond an individual's control when he was unaware of these factors? There has been extensive research completed on short-term rhythmic cycles, commonly referred to as "circadian rhythms" (1, 5, 13, 15, 17, 19, 20, 22). More recently, there has been considerable research completed on rhythms of longer duration. The term "biorhythms" has been associated with this research. Biorhythms was a term identified with the theory which proposed that three cyclical rhythms began at the moment of birth and occurred regularly throughout a person's life. These rhythmic patterns included the 23-day physical cycle, the 28-day emotional cycle, and the 33-day intellectual cycle (14).

The biorhythm theory proposed that three internal cycles were necessary to life. The cycles fluctuated in two directions. During the first half of the cycle, they were in a positive state. This was an indicator of the potentiality for a superior performance. The other phase of the cycle in a negative state was an indicator of a weakened condition that could result in the poor performance of what were normally routine tasks (10).

The cycles began in neutral. They flowed to a positive state, returned to neutral, and then reverted to a negative state. The significant period of time occurred when the cycle crossed the neutral or zero line. This was referred to as a critical period or critical day (10).

Research indicated that double and triple critical days magnified the possibilities for potential trouble. On the day that the three biorhythm cycles crossed the zero line simultaneously, it was believed that the chance for trouble was proportionately increased (10).

History of Biorhythms

The discovery of biorhythms was credited to two men who were active in the scientific world. Each man was unaware of the other's concurrent research on a similar subject. Dr. Hermann Swoboda of Vienna, Austria, and Dr. Wilhelm Fliess, an ear, nose and throat specialist in Berlin, Germany, were working along similar lines. Dr. Swoboda was directed toward biorhythm research from studying the work of Johann Friedrich Herbart. Herbart's Textbook on Psychology, published between 1850 and 1852, reported rhythmic changes in mental states, but could not offer an explanation why these changes occurred. Swoboda was impressed with a paper by Dr. Fliess on bisexuality in men, and by the research of John Beard, who in 1897 was investigating the regularity of timing in pregnancy and birth. Swoboda became involved in research that ranged from psychology and creative impulses to a compilation of records concerning pain, tissue swelling, and tissue inflammation. He plotted the course of fevers and various illnesses which included the frequency of heart attacks and bouts of asthma. From this research, Swoboda observed that all of these physical phenomena appeared to

recur rhythmically and that cycles of 23 and 28 days provided the evidence to predict their recurrence (10).

From the discovery of these two rhythms, Swoboda prepared a series of books developing the idea of human life cycles. This provided the biorhythm theory with the impetus to exert a stronger influence on doctors and laymen. At the same time, Swoboda developed a basic means for calculating one's biorhythm cycles. In 1909, he prepared a slide rule from which a person could calculate his critical days quickly and accurately. He published an instructional manual to use with this slide rule and named it "The Critical Days of Man" (10).

Swoboda's most outstanding work, entitled The Year of Seven, was devoted to proving the biorhythm theory through a mathematical analysis of how the timing of births tended to be rhythmical and predictable from generation to generation in the same family. The Year of Seven included an analysis of significant life events such as illness, heart attacks, and deaths. Swoboda believed these life events to be related to the genetic pattern of the family. By studying many family histories, Dr. Swoboda concluded that these events showed "a periodicity, a tendency to happen on critical days, that, interestingly enough, began with birth" (10, p. 42).

While Dr. Swoboda was completing his work in Vienna, Fliess was actively involved in biorhythmic research at the University of Berlin. During a period of 16 years, he published four volumes to support his investigation of biological rhythms (10).

The work completed by Dr. Fliess indicated that many of his primary investigations were completed with children and their variation in resistance to disease. He collected a copious amount of data

specific to the onset of illness, fever, and death, and was able to relate them to the day of birth. Between 1895 and 1905, many of his works and lectures supported the concept that the high and low resistance to disease lay in the 23-day and the 28-day cycles. This was his foundation to biorhythms (10).

Dr. Fliess continued to do research concerning the biorhythm theory and ultimately turned his attention to the investigation of cellular development. This research led to the formulation of the theory that the male and female cells of the human body had definite and different rhythms. He related the 28-day emotional cycle to the female cells and menstruation, and the 23-day physical cycle to the male cell. From this research, Dr. Fliess indicated that men underwent emotional cycles similar to those of female menstruation (10).

The conceptualization of the 33-day intellectual cycle was credited to an Austrian doctor, Alfred Teltcher. Dr. Teltcher maintained much data from scores on tests that were taken by many of his students. He matched these test scores with student birthdates. The results indicated significant periods of high and low intellectual achievement at various times of each month. This research led to the formulation of the 33-day intellectual cycle (10).

Despite the efforts by these outstanding scientists, the concept of long-term biological rhythms did not attract much attention throughout Europe for a period of 40 years (30).

By the 1960's, many European countries were accepting the credibility of this theory. This was observed through the use of biorhythms in the areas of industry, aviation, transportation, and medicine. In the far east, Japan was in the forefront as a nation who readily

accepted the biorhythm theory. The Japanese people used the three-cycle theory extensively in many phases of their lives. They supported this concept in medicine, aviation, industry, and their transportation system (30).

In the 1960's, the rhythms were given new impetus in research in the United States. Although the medical profession completed a sparse amount of research in this area that had not approached duplicating the efforts of their scientific counterparts in Europe, some investigations were completed in industry. It appears that the aviation industry reviewed the biorhythm theory with regard to the personnel who flew and guided their aircraft (10).

However, even with the current interest in the biorhythm theory, this biological phenomenon was not readily accepted in the United States. This nation remained far behind those other nations of the world who incorporated the theory of biological cycles into their daily lives.

Accidents

Thommen (30) indicated that one of the first significant studies on death by accident was completed in 1939. It was a study concerning the biorhythmic calculations of accident and death statistics based upon information concerning 700 accident cases. The research revealed that "of the 700 accidents analyzed, 322 fell on a single critical day, 74 others on a double critical day, and five on a triple critical day" (p. 30). The remaining 299 accidents occurred on normal days. "A total of 401 of the 700 accidents, almost 60 percent, occurred on critical days" (p. 30). This represented approximately "20 percent

of the days in a man's life" (p. 30). The other 299 accidents fell on the remaining 80 days of mixed-rhythm days.

A second study reported on by Thommen (30) was based upon 300 death statistics collected from civil records in the city of Zurich. Using the calculations from the 23-day physical cycle and the 28-day emotional cycle, the research indicated that from these "300 deaths, 197 of them fell on critical days and the remaining 103 occurred on mixed-rhythm days" (p. 42). Thus, "65 percent of the deaths fell on biorhythmic critical days" (p. 42). These critical days, considering only the physical and emotional cycles, occupied approximately 15 percent of the total number of days of a person's life.

Thommen (30) commented in September of 1956, concerning a report on the department of sanitation in Hanover, Germany. It dealt with accidents suffered by shop workers, street cleaners, and truck drivers. These accidents "were investigated and charted" by biorhythmic mathematics. The investigation of these accidents suffered by this work force indicated that "83 percent were related to biorhythmic critical days" (p. 35).

Thommen (30) reported that the Japanese were enthusiastically involved in the use of biorhythm information. A number of their industrial organizations, such as Fuji Heavy Industries, Mitsubishi Heavy Industries, and the Japanese transportation company, Ohmi Railway, plotted monthly biorhythmic charts for those employees who would be in possible accident situations. Workers and drivers received regular warnings to identify their critical days in each cycle.

Running contrary to all the supportive evidence of biorhythm involvement in industrial accidents was a report from Canada. The

Workmen's Compensation Board of British Columbia studied the records of lost time for occupational accidents during the first four months of 1971. The research involved 13,000 cases. Their results indicated a direct refutation of the biorhythm theory. This information indicated that accidents were no more likely to occur during the so-called critical days than at any other time (25).

Thommen (30) commented on research that was conducted with biorhythm cycles in the area of industrial safety. A study was completed utilizing information from approximately 300 accidents in four industries. This investigation revealed that nearly "70 percent of the accidents occurred on a critical day for the individual involved" (p. 36). From these studies it was concluded:

1. There was a definite change in the individual during the so-called critical days.

2. The study of the accident showed that the individual was unaware of this fact and could not understand why the accident occurred.

3. Critical days could be identified as to physical capabilities, mental capacity, as well as the mood of the individual (p. 36).

Mackenzie (21) stated that scientists at the Sandia Laboratories of Albuquerque, New Mexico, completed research on the biorhythm theory. Their investigations supported the possibility of a greater chance of accidents occurring during critical periods. The interpretation of this information was quite important.

> A person's age, health, character, and temperament must be taken into consideration in the application of biorhythms. Some people become excited or irritated more easily than others; some people are more accident-prone and cannot endure physical strain as well as others (p. 22).

O'Neil (26) commented on research involving industrial accidents. The investigation dealt with a study of 100 randomly selected vehicular accidents. When the data was collected concerning the biorhythmic patterns of each person, 68 percent of the accidents occurred on what were considered to be critical days. Additional research was completed to study the relationship between biorhythm cycles and industrial piecework. The study viewed biorhythms as a cyclical expenditure and conservation of one's energy as a factor in human performance. In this context, critical days must be put into proper perspective. These days could be dealt with and adjustments could be made with biorhythm cycles that would be beneficial to industrial safety programs.

Gittelson (12) worked with 50 major industrial companies on a two-year project dealing with accidents and critical days. He stated that the results were frightening: "We were finding a 60 to 80 percent correlation between accidents and critical days" (p. 1).

It appears that most of the information concerning the biorhythm theories and the susceptibility to accidents indicated a strong relationship between periods of instability and critical days and the potentiality of having an accident (30).

Aviation

Attention to the biorhythm theory has made a positive impression upon those persons and companies involved in the aviation industry. The Tactical Air Command surveyed 59 accidents resulting from pilot error. In 12 instances, the pilots were in a critical period, and 40 other pilots were low in at least two other cycles (30).

In 1973, the United Airlines San Francisco office of industrial

engineering, working with O'Neil (26), began a program to study the biorhythm theory. All of the United organizations received information about this biological phenomenon. The critical days of all the employees involved in the study were identified. Some departments participated for three years; other departments became involved for longer periods of time. Many departments who used the program during that period of 1974, showed a reduction in the number of injuries and accidents.

O'Neil's (26) research appeared to indicate that pilots as a group were less susceptible to the influence of the biorhythm cycles. A United spokesman indicated that perhaps "this was due to the intensive screening and training the pilots endured which made them more capable of overcoming critical days" (p. 60).

Thommen (30) stated that research specific to airline disasters occurring in the United States since 1970 indicated that, in each instance, the pilot was in a critical low in one of the biorhythm cycles and was approaching the same state in one of his other cycles.

Testimonials to the Fliess 23-day physical cycle theory and its potential relationship to aviation was presented in the Washington Post. The Post newspaper reported that a number of airlines were investigating the credibility of the 23-day theory. United Airlines was keeping a check on 28,000 of their employees. Allegheny, Trans World, and Continental Airlines had investigated and were exploring the credibility of the biorhythm theories (32).

A similar report supporting the biorhythm theories was also presented in the Washington Post. The report stated that some of the Japanese airline pilots were not permitted to fly on their critical days (33).

Further evidence to support the biorhythm theory was provided by the results of the varying degrees of success with different space flights. The one-orbit flight on July 21, 1961, by Gus Grissom, nearly ended in tragedy when the space capsule sank. Grissom was approaching the critical point in his emotional cycle and his physical and intellectual cycles were in a period of decline (30). John H. Glenn fared better on his three-orbit flight on February 20, 1962. His biorhythm chart at that time indicated a low in his physical and emotional cycles and an intellectual high (30). Glenn had a successful flight.

Contrast the Glenn experience with the flight of Scott Carpenter on May 24, 1962, when he overshot the landing target by 250 miles. His biorhythm chart indicated a critical point in the emotional cycle, a low point in the physical cycle, and a high point in the intellectual cycle (30). Walter M. Schirra, on October 3, 1962, completed a near perfect six-orbit flight. His biorhythm patterns that day were high in both the physical and emotional cycles and low in the intellectual cycle (30).

Finally, Thommen (30) stated that the application of the biorhythm theory using physiological cycles to determine the degree of physical fitness and mental alertness, while interesting still has not been widely accepted in the United States compared to those countries in Europe and in Japan.

Medicine

The field of medicine and medical research has proven to be a fertile area for the consideration and use of the biorhythm charts. To date, medical research in the United States concerning biorhythms

has not reached the same level of effort as compared to the work that has been completed in many other nations. Thommen stated:

> Testimonies from doctors in Switzerland and Germany reported the favorable use of biorhythmic mathematics in cases of elective surgery. The success rate with approximately 10,000 operations exhibited no failures or complications. This was attributed to the correct timing with the patients' biorhythmic charts. In those cases when the biorhythic cycles were not followed, complications arose in 30 to 60 percent of the cases (30, p. 79-80).

A pilot study in a New York hospital covered 28 operations. Following the surgeries, a biorhythm analysis was completed on each patient. Results from these analyses indicated that nine surgeries were performed on patients who were in a critical period. Three of these patients died following surgery. The surgical death rate in most U. S. hospitals has normally been 1 in 6,000 (2).

A medical study was completed by Bates and Heit (2) to determine if a relationship existed between biorhythm theory and significant occurrences in the daily activities of 20 male and female college students who were employed or involved in health studies. The subjects were requested to record significant occurrences for one month. Following this period of time, biological charts were prepared, and the results were plotted against their biorhythmic critical days. The results of this project were to reject the original hypothesis that significant occurrences would take place a minimum of 50 percent of the time on critical days. There were some significant occurrences; however, not to the projected 50 percent. The study recommended that the knowledge of biorhythmic patterns in terms of understanding a biological condition through a projected period of time could provide for "sensible planning of activities based upon more accurate assessments of body capabilities" (p. 38).

Dale (8) indicated that research was being completed with hormonal cycles. These studies indicated that the flow of hormones took place in a regular manner. This was substantiated through evidence of the production of insulin by the pancreas. During the study, researchers observed seasonal changes in the ability of certain cells to store essential biochemical ingredients.

Moss (23) did research on the menstrual cycle, and stated that this normal cyclical phenomenon was a classic example of extended human rhythms. While studying moods and symptoms specific to the menstrual cycle, he determined that personality traits varied rhythmically. The 15 women being observed were consistent from one period to the next in displaying symptoms of anxiety, depression and agressiveness.

There has been some evidence of research with biorhythm cycles concerning mental health and mental illness. Dale (8) indicated that timing and rhythmicity affected mental health in a number of ways. Included within this was periodic illness, stress, interruption in rhythmicity, insomnia, sleep rhythms, and the long-term disruptions caused by the continued use of medication. Initial reports indicated that drug-induced normalcy for problems such as hypertension, psychosis, manic depression, and catatonia brought with it certain hazards. One of these hazards was that no cure was effected. When the drugs were stopped, the symptoms returned even though the treatment was continued through the greater portion of the patient's life. Researchers concluded that such normalizing treatment could alter a person's cumulative rhythmic cycles.

Thommen (30) stated that periods of instability could last for two

to three days during the transition from the high to low point in the various cycles. This transitional time he described as a period of "critical" days. This was the time when the research concerning these theories cited that a person would be subject to greater periods of instability.

Thommen (30) theorized that a relationship could exist between a period of mental imbalance and biorhythms specific to a person committing an act of violence or an act that was unusual to his normal actions. Examples of this included Lee Harvey Oswald, who was in a severe emotional high when he assassinated John F. Kennedy. This act was immediately followed by Jack Ruby shooting and killing Oswald. Ruby was in a critical period in his physical and emotional cycles. Sirhan B. Sirhan was in a critical state in each cycle during the assassination of Robert Kennedy. On two occasions Marilyn Monroe attempted suicide. On the second attempt, during a critical physical cycle, Miss Monroe succeeded in taking her life. Finally, Judy Garland committed suicide during a physical and emotional low.

Athletics

Athletics seems to be a fertile area within which to investigate the relationship between biorhythmic patterns and the possibility of predicting human performance.

A victory or defeat may not provide a clearcut analysis specific to performance. Outside circumstances must be considered. Occasionally the biorhythmic condition acts as a subtle influence upon some people; at other times it is a decisive factor based upon other conditions (24). There has been some alarm concerning the number of people who claimed

that they were able to accurately predict motor performance based upon the 23-day physical cycle. Interviewed on the "Today" show, Wallerstein and Roberts (31) presented their research and predictions in evaluating a group of athletic performances of teams in the 1973 Super Bowl. They concluded that accurate predictions of the game demonstrated that group athletic performances and proficiencies were chartable to a working degree.

Thommen (30) stated that research concerning athletics and record performances indicated that when an athlete was high in the physical cycle, his ability to perform was in a favorable state. An example of this was the performance by Mark Spitz in the 1972 Olympics. Spitz exhibited a high physical and emotional rhythm during a week when he won seven gold medals. Pole-vaulter John Uelses set a world record in 1962, with a 16-foot vault, and at that time Uelses was in a physical and emotional high.

Baseball results were reported by Gittelson (11) concerning no-hit pitched games by such pitchers as Sandy Koufax, Bob Lemon, Don Larson, and many others. The records indicated that 9 of 11 no-hit games were pitched on days when the biorhythm physical cycle of the pitcher involved was in a favorable state. These results were compared to the sterling performance by Bob Gibson of the St. Louis Cardinals during one game of the 1968 World Series. He struck out a record 17 batters. His biorhythm cycles that day were all favorable. Gibson was experiencing a triple high.

There have been unlimited instances citing outstanding basketball feats and favorable biorhythmic conditions of the athletes involved. On November 17, 1960, Wilt Chamberlain of the Philadelphia 76ers pulled

down a record 55 rebounds. On that day, Chamberlain was experiencing a physical and emotional high (11). On March 12, 1961, Chamberlain once again rewrote a National Basketball Association record by scoring 100 points. This feat was accomplished with Chamberlain's biorhythmic patterns displaying a physical cycle moving from a neutral position to a high and an emotional cycle moving from a fair toward a critical state (26).

On October 30, 1976, Earl Monroe of the New York Knicks and Pete Maravich of the New Orleans Jazz completed a spectacular basketball performance in Madison Square Garden. Both players were experiencing similar biorhythmic cycles. Maravich was in an intellectual and emotional low, but was within 24 hours of a physical high. Monroe was experiencing a high in the physical cycle and a low in the emotional cycle. Each player produced a superior performance of offensive basketball on that date (11).

At the Wimbledon tennis championships in 1974, Ken Rosewell was extended in play during a semi-final match. His opponent in the finals the next day was Jimmy Connors. Rosewell went into the final match suffering from a double critical low in his physical and emotional cycles. From a biorhythmic perspective, Rosewell had a very poor chance for success in this match. He lost the match (16).

Contrary to all of the information that has been presented, consider the fact that Jesse Owens in the 1936 Olympics set a world record for the 100 meters on a critical day. One day later, during a biorhythmic low, the records indicated that Owens set an Olympic mark for the long jump and won the 200-meter dash. Russian gymnast Olga Korbut competing in the 1972 Olympics, completed a magnificent gymnastic

performance. She won gold medals despite the fact that her biorhythm charts revealed a physical and emotional low during her days of competition. The Muhammad Ali and George Foreman title fight in Zaire in October of 1974 provided interesting information concerning the biorhythmic status of each fighter. Foreman was on a high in each cycle, while Ali projected a low physical biorhythmic cycle. On the basis of their biorhythm charts, Foreman should have won the fight; however, Ali won by a knockout in the eighth round (26).

Krause (16) commented that the coach of the Swiss championship soccer team for the FC Basel, used the biorhythm theory on himself for a period of two years before he considered applying this concept with his soccer players. Based upon the biorhythm profiles computed prior to competition, certain levels of expected performance were anticipated. It became obvious there existed a distinct tendency between the degree of performance of individual players and their biorhythmic profiles. The information stated that it was not in the best interest to severely train a player whose biorhythms indicated a low or critical day. The so-called "hard conditioning training," which was energy consuming, should be utilized at a time when a player was in a biorhythm high. At that time, the organism had a great deal of energy and was able to use it without danger of exhaustion. The FC Basel coach, rather than over-emphasizing biorhythms, was convinced that with the knowledge and understanding of these theories, a conscientious coach has the means to improve player performance.

In sports such as golf, chess, and other individual activities where extreme mental concentration was required, the outcome of an event appeared to be predictable with amazing certainty provided the

opponents were of equal skill. In support of this concept of the biorhythm theory was the Fischer/Spasky World Championship chess match. During the course of the match, Fischer was experiencing favorable biorhythm cycles during many of the days of scheduled competition and low cycles during the days when no competition was to take place. Fischer won the chess match rather convincingly (16).

Finally, Willis (34) commented about the relationship of biorhythms and human errors in October of 1972, at the 17th annual meeting of the Human Factors Society. He stated that during positive phases of the biorhythm cycles, hard conditioning and training programs were acceptable. Conversely, during low phases of these cycles more rest and no exertion would be better for the athlete.

Willis (34) conducted a survey at Missouri Southern State College. A quarterback rated each player daily on effort, execution of task, mistakes, attitude, endurance, and self control. The research on these performances indicated, by critical days, that the categories gave approximately a 60 percent prediction of performance. Willis further stated that an awareness of the athlete's 23-day cycle would provide the coach with the information as to when he could anticipate a peak performance. It would also permit a coach to select players who were in a state more likely to produce a successful performance. The awareness of the biorhythm curves of the opposition would also enable a coach to gear the play of his team accordingly.

Biorhythm Calculations

It is not too difficult to calculate one's biorhythm cycles. The easiest procedure to follow would be to program it on a computer.

Recently a number of successful businesses have been selling various types of hand calculators that could be used to plot a biorhythm chart. A more tedious method would be to complete the calculations by hand. In order to do this, a number of steps must be followed. They are:

1. Compute the total number of days lived since the day of birth up to the date that is to be included in the calculations.

2. After the number of days are totaled, divide this composite number separately by the numbers 23, 28, and 33, respective of each cycle.

3. The division in step #2 determines how many times each cycle has occurred in a person's life. The days that remain from each cycle following the division indicates the position of each rhythm on the first day of the calendar month to be charted (30, p. 74).

Future of Biorhythms

According to Gittelson (11), biorhythms may be associated with many subjects ranging from medicine, safety, and aviation, to athletics. There could be an important future for these theories as they relate to man. Some unanswered questions are why do the biological rhythms exist and what constitutes their physical basis? How do they interact with other life cycles? Why do individuals vary in susceptibility to biological cycles? Why are some persons strongly influenced by these rhythms and others are not? How are rhythms influenced, weakened, strengthened, or altered by the environment or different stages of life or circumstances? How can man be taught to adapt and use biological cycles?

The questions are broad in scope and are difficult to answer. It will require a great deal of detailed investigation to generate some answers (11).

The interpretation of the biorhythm curves presents a problem that is worthy of research and study. While the nature and consequence of critical days are known, as well as the ability to interpret triple highs and lows with reasonable accuracy, mixed rhythm days remain less clear. Gittelson (11) commented that the direction of the curves may be important as well as whether the rhythm is above or below the neutral line. Opposing rhythms have recently been researched. It has been maintained that days of "opposing crossings" can be classified similarly to critical days involving rhythmic instability or confusion. If a rising physical rhythm crosses an emotional rhythm that is declining, an individual may experience conflict and confusion.

Summary

Current research presents conflicting information regarding the influence exerted by the three biorhythm cycles. Do these cycles depend upon secondary factors such as age, level of education, personality, and health conditions? O'Neil (26, p. 3) stated that "a critical day does not appear to affect everyone in a similar manner."

Reams (28) concluded that human performance was not affected by the biorhythm cycles in his research that involved human performance activities such as muscular endurance, coordination reaction time, and fine precision tasks (hand steadiness), among others.

Sachs (29) completed a study with female varsity softball players at Florida State University. He measured softball playing performance in hitting, fielding, and overall attitude and play. His conclusions indicated that there were no consistent relationships among the three biorhythm cycles and softball playing performance.

Cawiezel (6) indicated that there were no relationships between dart throwing and the physical biorhythm cycle with selected groups of men and women in physical education classes at Chadron State College, Nebraska.

Thommen (30) commented that the 23-day physical cycle affected man's physical strength, endurance, energy, resistance to disease, and physical confidence. The first half of the cycle was the rising or discharge period. During this period of time a person may exhibit a vital and vigorous state of being. Athletes usually performed best at this time. The second half of the 23-day cycle was the recharge period. During that period of time a person might tire more quickly. Athletes might not perform well at this time since it was presumed that they would have less reserve power, energy, and endurance. Medical researchers considered the recharge period as necessary for recuperation since a person would more likely accept that period as a time of rest.

Thommen (30) believed that the 28-day cycle governed the nervous system. The initial 14 days represented the positive or discharge period. At that time a person was inclined to optimism and cheerfulness. During the second half of the cycle, in a period of recharge, the person might display higher levels of irritability and negativism.

The 33-day cycle, according to Thommen (30), originated in the brain cells and this phenomenon was related to a secretion from the thyroid gland. During the first half of the cycle the person should think more clearly, the memory function better, and the individual's mental response should be more spontaneous. This period of time was best for absorbing new subjects and for creative thinking. The second

half of the cycle indicated that the person's intellectual capabilities were less responsive.

Each cycle indicated high and low periods. It was the movement in either direction through the neutral line when a critical day occurred. These critical days were normally 24 hours in duration. It was hypothesized that a person was susceptible to difficult times during this period (30).

According to Thommen (30), the exact time of birth was quite important specific to the accuracy of establishing a biorhythm chart. As an example, a baby born just after midnight of the next given day would display a different cyclic pattern than another baby born the same day but 23 hours later as the time was rapidly moving toward the next day.

Other research indicated that biological rhythms were regular and recurring in living organisms. This was more of a description than an explanation. There were various interpretations and most of them were conflicting. The theories were divided into two areas. One area indicated that the cycles were activated by external forces. The research that accepted this belief indicated that external cosmic forces controlled biological rhythms. Other research supported the idea of tidal influences and the effect of electro-magnetic forces. Finally, there was the suggestion that sunspot activity was the activator (8).

Research that supported the internal theory suggested that the heredity phenomenon was regulated by a "chronon, a type of molecular timepiece that was directly incorporated in the DNA molecule" (8, p. 168). Another investigation indicated that "biological rhythms were acquired or adaptive behavior which was learned in response to lunar phases and changing seasons" (8, p. 168).

The mystery has remained. Do biorhythm patterns have a cyclical effect on the human body? Perhaps more time and investigation pertinent to this natural phenomenon would provide a concrete and final answer.

CHAPTER III

METHODS AND PROCEDURE

Subjects

The subjects involved in this study were male basketball players from selected colleges and universities. The schools providing information were the University of Science and Arts of Oklahoma, Bethany Nazarene College, Phillips University, Oklahoma Christian College, Southwestern State University, Southeastern State University, Bartlesville Wesleyan College, Oklahoma Baptist University, Evangel College, Midwestern University, and Ouachita Baptist University.

Procedure

A letter shown in Appendix A introducing the study was sent to the basketball coach of each institution. The purpose of the study was explained in the letter and each coach who was willing to cooperate was requested to provide the following information: a roster of all players, their respective birthdates, a copy of the 1977-78 basketball schedule and a copy of all statistics for each game played during the 1977-78 basketball season from the official scorebook. A sample biorhythm chart for each subject is shown in Appendix B.

The information concerning each player, his birthdate and his foul shooting statistics for each game played during the 1977-78 intercollegiate basketball season, were subjected to a statistical review. The

following statistics were used to determine the effects of biorhythm performances:

For each subject the following was calculated:

$$p = \frac{\text{total free throws made}}{\text{total free throws attempted}}$$

The games each player participated in were divided into nine categories according to his biorhythm chart:

1. Physical-up/Emotional-up;
2. Physical-up/Emotional down;
3. Physical-down/Emotional-up;
4. Physical-down/Emotional-down;
5. Physical-critical/Emotional-up;
6. Physical-up/Emotional-critical;
7. Physical-down/Emotional-critical;
8. Physical-critical/Emotional-down;
9. Physical-critical/Emotional-critical.

For each player the following binomial calculations were completed:

$$P(y) = \binom{n}{y} p^y (1-p)^{n-y}$$

The number of free throws attempted during the category is n and the number of free throws made is y.

An example of this is the following: Player #1 for whom p = .5 attempted ten free throws, at the time the physical state was high and the emotional state was high, and made six of them. The entry under column 1, row 1, would be:

$$p(6) = \binom{10}{6} (.5)^6(1-.5)^4$$

$$\frac{10!}{6!4!}(.015625)\ (.0625)$$

$$(210)\ (.015625)\ (.0625) = .205078$$

This is the probability of Player #1, making six out of ten free throws.

The table of probabilities was displayed in this manner:

	Categories								
	1	2	3	4	5	6	7	8	9
Player #1	.205								
2									
3									
4									
.									
.									
.									
.									
91									

An anlysis of variance was used to test whether or not there was a significant difference in performance. If the F was significant then t-tests were performed to find where the differences existed.

CHAPTER IV

RESULTS

The purpose of this study was to determine if a relationship existed between free throw accuracy and the 23-day physical and the 28-day emotional biorhythmic cycles. Information was compiled on a total of 91 subjects. These individuals were varsity basketball players from selected colleges and universities.

The information to complete this study was obtained through letters sent to the basketball coaches of the selected institutions. In each instance where information was provided, a five-month biorhythmic chart was prepared on each subject. Foul shooting results from each game played were matched with the corresponding date from each subject's biorhythm chart. This information was treated through the use of a binomial statistical formula and the results of the study are presented within this chapter.

From the records of free throws made and free throws attempts by the 91 subjects, the performance during each of the nine categories was recorded as shown in Table V (Appendix C), Number of Free Throws Made During Each Phase of the Biorhythmic Cycle. If the subject did not attempt a free throw during a biorhythmic cycle, then the subject was not used in calculating the descriptive statistics. The binomial probability formula

$$P(y) = \binom{n}{y} p^{y}(1-p)^{n-y}$$

was used to calculate the probability for the number of free throws made, X out of N attempts; given that the subject made p% for the season and missed q%. A history of the probabilities is in Table VI, Probabilities for Free Throws Made During Each Phase of the Biorhythmic Cycle. (Tables V and VI shown in Appendix C.) A summation of the descriptive statistics in each category is shown in Table I.

Analysis of Variance

Initially an analysis of variance was utilized to determine if any variations occurred between the various categories which were:

Category I	Physical-up	/ Emotional-up
Category II	Physical-up	/ Emotional-down
Category III	Physical-down	/ Emotional-up
Category IV	Physical-down	/ Emotional-down
Category V	Physical-critical	/ Emotional-up
Category VI	Physical-up	/ Emotional-critical
Category VII	Physical-down	/ Emotional-critical
Category VIII	Physical-critical	/ Emotional-down
Category IX	Physical-critical	/ Emotional-critical

The possibility of two hypotheses existed. The null hypothesis indicated that all means in the nine categories were equal. The alternate hypothesis indicated there were at least two means which differed.

H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7 = \mu_8 = \mu_9$

H_1: There are at least two means such that $\mu_i \neq \mu_j$

Since the numbers of scores differed among the categories, the total variation between groups was calculated as:

TABLE I

SUMMATION OF DESCRIPTIVE STATISTICS FOR EACH CATEGORY

Descriptive Statistics	I	II	III	IV	V	VI	VII	VIII	IX
Total free throws made	821	826	1054	1033	233	112	139	137	29
Total free throws attempted	1197	1217	1525	1500	316	155	202	193	44
Mean of Probabilities	.227	.211	.204	.183	.288	.293	.292	.372	.306
Number of students in sample	90	87	91	88	49	29	35	42	12

$$\text{SS between} = \frac{\sum_{i=1}^{9} \left(\frac{\sum_{J=1}^{m_i} X_j}{n\tau} \right)^2 \left(\frac{\sum_{J=1}^{N_i} X\sigma}{n\tau} \right)^2}{8}$$

The total variation within groups was calculated as:

$$\text{SS within} = \frac{\Sigma X_i^2 - \sum_{i=1}^{9} \frac{\left(\sum_{j=1}^{n_i} X_j \right)}{n_i}}{N_\tau - 8}$$

Total scores: N_t - 523

Degrees of freedom between = 8

Degrees of freedom within - N_t - 9 = 514

MS between = SS between / 8

MS within = SS within / 514

$$F = \frac{\text{MS between}}{\text{MS within}}$$

The critical value of F at the .05 level of confidence was

$$F_{.05}\ (8.514) = 1.94$$

and the F at the .01 level of confidence was

$$F_{.01}\ (8.514) = 2.51.$$

The information for the analysis of variance is presented in Table II which represents Results of Analysis of Variance, and Table III which represents Summary of Analysis of Variance.

TABLE II

RESULTS OF ANALYSIS OF VARIANCE

Source	SS	DF	MS	F
Between	1.5703	8	.1963	12.5614
Within	8.0317	514	.0156	

Based upon these calculations, since F = 12.5614 was greater than 2.51, the null hypothesis was rejected indicating that a significant difference did exist in the various categories. Therefore, t-tests were performed on each pair of categories to determine where the differences existed.

t-Tests

A t-test was performed on each pair of categories. Since the number of scores differed in the categories, the t values were clacu-lated by:

$$t_{m_1 + m_2 - z} = \frac{\bar{X}_1 - \bar{X}_2}{\left(\sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}} \left(\frac{1}{n_1} \tau \frac{1}{n_2} \right) \right)}$$

TABLE III

SUMMARY OF ANALYSIS OF VARIANCE

	I	II	III	IV	V	VI	VII	VIII	IX	Total
ΣX	20.439	18.353	18.351	16.099	14.095	8.496	10.223	15.637	3.671	125.54
$(\Sigma X)^2$	417.76	336.82	343.38	259.16	198.68	72.19	104.50	244.52	13.48	1990.49
N	90	87	91	88	49	29	35	42	12	523
D.F.	89	86	90	87	48	28	34	41	11	514
$(\Sigma X)^2/N$	4.642	3.871	3.773	2.945	4.055	2.489	2.986	5.822	1.123	
ΣX^2	5.887	4.991	5.311	3.768	4.784	3.327	3.716	6.613	1.340	39.74

The results of all of the t-tests are as follows:

Physical-up/Emotional-up vs. Physical-up/ Emotional-down

$H_o = \mu_1 = \mu_2$

$H_1 = \mu_1 \neq \mu_2$

D. F. = 175

Critical values $t_{.01} = \pm 2.58$

$t_{.05} = \pm 1.96$

Results.

Mean of Physical-up and Emotional-up	= .2271
Mean of Physical-up and Emotional-down	= .2109
Variance of Physical-up and Emotional-up	= .0138
Variance of Physical-up and Emotional-down	= .0266
Number of Players in Physical-up and Emotional-up	= 90
Number of Players in Physical-up and Emotional-down	= 87

$t = .7571$

Since $t < 1.96$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-up vs. Physical-down/ Emotional-up

$H_o = \mu_1 = \mu_3$

$H_1 = \mu_1 \neq \mu_3$

D. F. = 179

Critical values $t_{.01} = \pm 2.58$

$t_{.05} = \pm 1.96$

Results.

Mean of Physical-up and Emotional-up = .2271

Mean of Physical-up and Emotional-up = .2036

Variance of Physical-up and Emotional-up = .0138

Variance of Physical-down and Emotional-up = .0424

Number of Players in Physical-up and Emotional-up = 90

Number of Players in Physical-down and Emotional-up = 91

$t = .9403$

Since $t < 1.96$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-up vs. Physical-down/ Emotional-down

$H_o = \mu_1 = \mu_4$

$H_1 = \mu_1 \neq \mu_4$

D. F. = 176

Critical values $t_{.01} = \pm 2.58$

$t_{.05} = \pm 1.96$

Results.

Mean of Physical-up and Emotional-up = .2271

Mean of Physical-down and Emotional-down = .1829

Variance of Physical-up and Emotional-up = .0138

Variance of Physical-down and Emotional-down = .0531

Number of Players in Physical-up and Emotional-up = 90

Number of Players in Physical-down and Emotional-down = 88

$$t = 1.6153$$

Since $t < 1.96$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-up vs. Physical-critical/Emotional-up

$$H_o = \mu_1 = \mu_5$$

$$H_1 = \mu_1 \neq \mu_5$$

D. F. = 137

Critical values $t_{.01} = \pm 2.58$

$t_{.05} = \pm 1.96$

Results.

Mean of Physical-up and Emotional-up = .2271

Mean of Physical-critical and Emotional-up = .2876

Variance of Physical-up and Emotional-up = .0138

Variance of Physical-critical and Emotional-up = .1019

Number of Players in Physical-up and Emotional-up = 90

Number of Players in Physical-critical and Emotional-up = 49

$$t = -1.6138$$

Since $t < 1.96$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-up vs. Physical-up/

Emotional-critical

$H_o = \mu_1 = \mu_6$

$H_1 = \mu_1 \neq \mu_6$

D. F. = 117

Critical values $t_{.01} = \pm 2.58$

$t_{.05} = \pm 1.96$

Results.

Mean of Physical-up and Emotional-up	= .2271
Mean of Physical-up and Emotional-critical	= .2929
Variance of Physical-up and Emotional-up	= .0138
Variance of Physical-up and Emotional-critical	= .1891
Number of Players in Physical-up and Emotional-up	= 90
Number of Players in Physical-up and Emotional-critical	= 29

$t = -1.3065$

Since $t < 1.96$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-up vs. Physical-down/

Emotional-critical

$H_o = \mu_1 = \mu_7$

$H_1 = \mu_1 \neq \mu_7$

D. F. = 123

Critical values $t_{.01} = \pm 2.63$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-up	=	.2271
Mean of Physical-down and Emotional-critical	=	.2920
Variance of Physical-up and Emotional-up	=	.0138
Variance of Physical-down and Emotional-critical	=	.1693
Number of Players in Physical-up and Emotional-up	=	90
Number of Players in Physical-down and Emotional-critical	=	35

$$t = -1.3686$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-up vs. Physical-critical/ Emotional-down

$$H_o = \mu_1 = \mu_8$$

$$H_1 = \mu_1 \neq \mu_8$$

D. F. = 130

Critical values $t_{.01} = \pm 2.6$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-up	=	.2271
Mean of Physical-critical and Emotional-down	=	.3723
Variance of Physical-up and Emotional-up	=	.0138
Variance of Physical-critical and Emotional-down	=	.1486
Number of Players in Physical-up and Emotional-up	=	90
Number of Players in Physical-critical and Emotional-down	=	42

$$t = -3.2737$$

There was a significant difference in category I and category VIII at the .01 level of confidence. Since -3.2737 <-2.6, there was a significant difference in these means. Therefore, the null hypothesis was rejected.

Physical-up/Emotional-up vs. Physical-critical/ Emotional-critical

$H_o = \mu_1 = \mu_9$

$H_1 = \mu_1 \neq \mu_9$

D. F. = 100

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-up	= .2271
Mean of Physical-critical and Emotional-critical	= .3059
Variance of Physical-up and Emotional-up	= .0138
Variance of Physical-critical and Emotional-critical	= .5248
Number of Players in Physical-up and Emotional-up	= 90
Number of Players in Physical-critical and Emotional-critical	= 12

$t = -.9690$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-down vs. Physical-down/Emotional-up

$H_o = \mu_2 = \mu_3$

$H_1 = \mu_2 \neq \mu_3$

D. F. = 176

Critical values $t_{.01} = \pm 2.6$

$t_{.05} = \pm 1.97$

Results.

Mean of Physical-up and Emotional-down	= .2109
Mean of Physical-down and Emotional-up	= .2036
Variance of Physical-up and Emotional-down	= .0266
Variance of Physical-down and Emotional-up	= .0424
Number of Players in Physical-up and Emotional-down	= 87
Number of Players in Physical-down and Emotional-up	= 91

$t = .2618$

Since $t < 1.97$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-down vs. Physical-down/Emotional-down

$H_o = \mu_2 = \mu_4$

$H_1 = \mu_2 \neq \mu_4$

D. F. = 173

Critical values $t_{.01} = \pm 2.6$

$t_{.05} = \pm 1.97$

Results.

Mean of Physical-up and Emotional-down	=	.2109
Mean of Physical-down and Emotional-down	=	.1829
Variance of Physical-up and Emotional-down	=	.0266
Variance of Physical-down and Emotional-down	=	.0531
Number of Players in Physical-up and Emotional-down	=	87
Number of Players in Physical-down and Emotional-down	=	88

$$t = .9262$$

Since $t < 1.97$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-down vs. Physical-critical/Emotional-up

$$H_o = \mu_2 = \mu_5$$

$$H_1 = \mu_2 \neq \mu_5$$

D. F. = 134

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-down	=	.2109
Mean of Physical-critical and Emotional-up	=	.2876
Variance of Physical-up and Emotional-down	=	.0266
Variance of Physical-critical and Emotional-up	=	.1019
Number of Players in Physical-up and Emotional-up	=	87
Number of Players in Physical-critical and Emotional-up	=	49

$$t = -1.8543$$

Since t < 1.98, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-down vs. Physical-up/ Emotional-critical

$H_o = \mu_2 = \mu_6$

$H_1 = \mu_2 \neq \mu_6$

D. F. = 114

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-down	= .2109
Mean of Physical-up and Emotional-critical	= .2929
Variance of Physical-up and Emotional-down	= .0266
Variance of Physical-up and Emotional-critical	= .1891
Number of Players in Physical-up and Emotional-down	= 87
Number of Players in Physical-up and Emotional-critical	= 29

$t = -1.4825$

Since t < 1.98, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-down vs. Physical-down/ Emotional-critical

$H_o = \mu_2 = \mu_7$

$H_1 = \mu_2 \neq \mu_7$

D. F. = 120

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-down	=	.2109
Mean of Physical-down and Emotional-critical	=	.2920
Variance of Physical-up and Emotional-down	=	.0266
Variance of Physical-down and Emotional-critical	=	.1693
Number of Players in Physical-up and Emotional-down	=	87
Number of Players in Physical-down and Emotional-critical	=	35

$$t = -1.5645$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-down vs. Physical-critical/ Emotional-down

$H_o = \mu_2 = \mu_8$

$H_1 = \mu_2 \neq \mu_8$

D. F. = 127

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-down	=	.2109
Mean of Physical-critical and Emotional-down	=	.3723
Variance of Physical-up and Emotional-down	=	.0266
Variance of Physical-critical and Emotional-down	=	.1486

Number of Players in Physical-up and Emotional-down = 87

Number of Players in Physical-critical and Emotional-down = 42

$$t = -3.3409$$

There was a significant difference in category II and category VIII at the .01 level of confidence. Since $-3.3409 < -2.62$, there was a significant difference in these means. Therefore, the null hypothesis was rejected.

Physical-up/Emotional-down vs. Physical-critical/ Emotional-critical

$$H_o = \mu_2 = \mu_9$$

$$H_1 = \mu_2 \neq \mu_9$$

D. F. = 97

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-up and Emotional-down = .2109

Mean of Physical-critical and Emotional-critical = .3059

Variance of Physical-up and Emotional-down = .0266

Variance of Physical-critical and Emotional-critical = .5248

Number of Players in Physical-up and Emotional-down = 87

Number of Players in Physical-critical and Emotional-critical = 12

$$t = -1.0691$$

Since $t < 1.98$, the null hypothesis was accapted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-up vs. Physical-down/ Emotional-down

$H_o = \mu_3 = \mu_4$

$H_1 = \mu_3 \neq \mu_4$

D. F. = 177

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.97$

Results.

Mean of Physical-down and Emotional-up	= .2036
Mean of Physical-down and Emotional-down	= .1829
Variance of Physical-down and Emotional-up	= .0424
Variance of Physical-down and Emotional-down	= .0531
Number of Players in Physical-down and Emotional-up	= 91
Number of Players in Physical-down and Emotional-down	= 88

$t = .6337$

Since $t < 1.97$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-up vs. Physical-critical/Emotional-up

$H_o = \mu_3 = \mu_5$

$H_1 = \mu_3 \neq \mu_5$

D. F. = 138

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-up = .2036

Mean of Physical-critical and Emotional-up = .2876

Variance of Physical-down and Emotional-up = .0424

Variance of Physical-critical and Emotional-up = .1019

Number of Players in Physical-down and Emotional-up = 91

Number of Players in Physical-critical and Emotional-up = 49

$$t = -1.8876$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-up vs. Physical-up/ Emotional-critical

$H_o = \mu_3 = \mu_6$

$H_1 = \mu_3 \neq \mu_6$

D. F. = 118

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-up = .2036

Mean of Physical-up and Emotional-critical = .2929

Variance of Physical-down and Emotional-up = .0424

Variance of Physical-up and Emotional-critical = .1891

Number of Players in Physical-down and Emotional-up = 91

Number of Players in Physical-up and Emotional-critical = 29

$$t = -1.5077$$

Since t < 1.98, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-up vs. Physical-down/ Emotional-critical

$H_o = \mu_3 = \mu_7$

$H_1 = \mu_3 \neq \mu_7$

D. F. = 124

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-up	= .2036
Mean of Physical-down and Emotional-critical	= .2920
Variance of Physical-down and Emotional-up	= .0424
Variance of Physical-down and Emotional-up	= .1693
Number of Players in Physical-down and Emotional-up	= 91
Number of Players in Physical-down and Emotional-critical	= 35

t = -1.6002

Since t < 1.98, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-up vs. Physical-critical/Emotional-down

$H_o = \mu_3 = \mu_8$

$H_1 = \mu_3 \neq \mu_8$

D. F. = 131

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-up = .2036

Mean of Physical-critical and Emotional-down = .3723

Variance of Physical-down and Emotional-up = .0424

Variance of Physical-critical and Emotional-down = .1486

Number of Players in Physical-down and Emotional-up = 91

Number of Players in Physical-critical and Emotional-down = 42

$t = -3.2869$

There was a significant difference in category III and category VIII at the .01 level of confidence. Since $-3.2869 < -2.62$, there was a significant difference in these means. Therefore, the null hypothesis was rejected.

Physical-down/Emotional-up vs. Physical-critical/Emotional-critical

$H_o = \mu_3 = \mu_9$

$H_1 = \mu_3 \neq \mu_9$

D. F. = 101

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-up = .2036

Mean of Physical-critical and Emotional-critical = .3059

Variance of Physical-down and Emotional-up = .0424

Variance of Physical-critical and Emotional-critical = .5248

Number of Players in Physical-down and Emotional-up = 91

Number of Players in Physical-critical and Emotional-critical = 12

$$t = -1.0806$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-down vs. Physical-critical/Emotional-up

$$H_o = \mu_4 = \mu_5$$

$$H_1 = \mu_4 \neq \mu_5$$

D. F. = 135

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-down = .1829

Mean of Physical-critical and Emotional-up = .2876

Variance of Physical-down and Emotional-down = .0531

Variance of Physical-critical and Emotional-up = .1019

Number of Players in Physical-down and Emotional-down = 88

Number of Players in Physical-critical and Emotional-up = 49

$$t = -2.2127$$

There was a significant difference at the .05 level of confidence, but not at the .01 level between category IV and category V. Since

$-2.21267 < -1.98$, there was a significant difference in these means. Therefore, the null hypothesis was rejected.

Physical-down/Emotional-down vs. Physical-up/ Emotional-critical

$$H_o = \mu_4 = \mu_6$$

$$H_1 = \mu_4 \neq \mu_6$$

D. F. = 115

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-down	=	.1829
Mean of Physical-up and Emotional-critical	=	.2929
Variance of Physical-down and Emotional-down	=	.0531
Variance of Physical-up and Emotional-critical	=	.1891
Number of Players in Physical-down and Emotional-down	=	88
Number of Players in Physical-up and Emotional-critical	=	29

$$t = -1.7497$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-down vs. Physical-down/Emotional-critical

$$H_o = \mu_4 = \mu_7$$

$$H_1 = \mu_4 \neq \mu_7$$

D. F. = 121

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-down	= .1829
Mean of Physical-down and Emotional-critical	= .2920
Variance of Physical-down and Emotional-down	= .0531
Variance of Physical-down and Emotional-critical	= .1693
Number of Players in Physical-down and Emotional-down	= 88
Number of Players in Physical-down and Emotional-critical	= 35

$t = -1.8644$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-down vs. Physical-critical/Emotional-down

$H_o = \mu_4 = \mu_8$

$H_1 = \mu_4 \neq \mu_8$

D. F. = 128

Critical values $t_{.01} = \pm 2.62$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-down	= .1829
Mean of Physical-critical and Emotional-down	= .3723
Variance of Physical-down and Emotional-down	= .0531
Variance of Physical-critical and Emotional-down	= .1486

Number of Players in Physical-down and Emotional-down = 88

Number of Players in Physical-critical and Emotional-down = 42

$$t = -3.4889$$

There was a significant difference at the .01 and .05 level of confidence between category IV and category VIII. Since $-3.4889 < -2.62$, there was a significant difference in these means. Therefore, the null hypothesis was rejected.

Physical-down/Emotional-down vs. Physical-critical/Emotional-critical

$H_o = \mu_4 = \mu_9$

$H_1 = \mu_4 \neq \mu_9$

D. F. = 98

Critical values $t_{.01} = \pm 2.62$

$t_{.01} = \pm 1.98$

Results.

Mean of Physical-down and Emotional-down = .1829

Mean of Physical-critical and Emotional-critical = .3059

Variance of Physical-down and Emotional-down = .0531

Variance of Physical-critical and Emotional-critical = .5248

Number of Players in Physical-down and Emotional-down = 88

Number of Players in Physical-critical and Emotional-critical = 12

$$t = -1.2266$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-critical/Emotional-up vs. Physical-up/ Emotional-critical

$H_o = \mu_5 = \mu_6$

$H_1 = \mu_5 \neq \mu_6$

D. F. = 76

Critical values $t_{.01} = \pm 2.63$

$t_{.05} = \pm 1.99$

Results.

Mean of Physical-critical and Emotional-up	= .2876
Mean of Physical-up and Emotional-critical	= .2929
Variance of Physical-critical and Emotional-up	= .1019
Variance of Physical-up and Emotional-critical	= .1891
Number of Players in Physical-critical and Emotional-up	= 49
Number of Players in Physical-up and Emotional-critical	= 29

$t = -.0620$

Since $t < 1.99$, the null hypothesis was accepted which stated there was no difference in the means of the two categories.

Physical-critical/Emotional-up vs. Physical-down/Emotional-critical

$H_o = \mu_5 = \mu_7$

$H_1 = \mu_5 \neq \mu_7$

D. F. = 82

Critical values $t_{.01} = \pm 2.63$

$t_{.05} = \pm 1.99$

Results.

Mean of Physical-critical and Emotional-up = .2876

Mean of Physical-down and Emotional-critical = .2920

Variance of Physical-critical and Emotional-up = .1019

Variance of Physical-down and Emotional-critical = .1693

Number of Players in Physical-critical and Emotional-up = 49

Number of Players in Physical-down and Emotional-critical = 35

$$t = -.0553$$

Since $t < 1.99$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-critical/Emotional-up vs. Physical-critical/Emotional-down

$H_o = \mu_5 = \mu_8$

$H_1 = \mu_5 \neq \mu_8$

D. F. = 89

Critical values $t_{.01} = \pm 2.63$

$t_{.05} = \pm 1.98$

Results.

Mean of Physical-critical and Emotional-up = .2876

Mean of Physical-critical and Emotional-down = .3723

Variance of Physical-critical and Emotional-up = .1019

Variance of Physical-critical and Emotional-down = .1486

Number of Players in Physical-critical and Emotional-up = 49

Number of Players in Physical-critical and Emotional-down = 42

$$t = -1.1457$$

Since $t < 1.98$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-critical/Emotional-up vs. Physical-critical/Emotional-critical

$H_o = \mu_5 = \mu_9$

$H_1 = \mu_5 \neq \mu_9$

D. F. = 59

Critical values $t_{.01} = \pm 2.66$

$t_{.05} = \pm 2.00$

Results.

Mean of Physical-critical and Emotional-up	= .2876
Mean of Physical-critical and Emotional-critical	= .3059
Variance of Physical-critical and Emotional-up	= .1019
Variance of Physical-critical and Emotional-critical	= .5248
Number of Players in Physical-critical and Emotional-up	= 49
Number of Players in Physical-critical and Emotional-critical	= 12

$$t = -.1332$$

Since $t < 2.00$, the null hypothesis was accepted which stated there was no differences in the means of these two categories.

Physical-up/Emotional-critical vs. Physical-down/Emotional-critical

$H_o = \mu_6 = \mu_7$

$H_1 = \mu_6 \neq \mu_7$

D. F. = 62

Critical values $t_{.01} = \pm 2.66$

$t_{.05} = \pm 2.00$

Results.

Mean of Physical-up and Emotional-critical = .2929

Mean of Physical-down and Emotional-critical = .2920

Variance of Physical-up and Emotional-critical = .1891

Variance of Physical-down and Emotional-critical = .1693

Number of Players in Physical-up and Emotional-critical = 29

Number of Players in Physical-down and Emotional-critical = 35

$t = .0085$

Since $t < 2.00$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-up/Emotional-critical vs. Physical-critical/Emotional-down

$H_o = \mu_6 = \mu_8$

$H_1 = \mu_6 \neq \mu_8$

D. F. = 69

Critical values $t_{.01} = \pm 2.64$

$t_{.05} = \pm 1.99$

Results.

Mean of Physical-up and Emotional-critical = .2929

Mean of Physical-critical and Emotional-down = .3723

Variance of Physical-up and Emotional-critical = .1891

Variance of Physical-critical and Emotional-down = .1486

Number of Players in Physical-up and Emotional-critical = 29

Number of Players in Physical-critical and Emotional-down = 42

$$t = -.8087$$

Since $t < 1.99$, the null hypothesis was accepted which stated there was no difference in the means of the two categories.

Physical-up/Emotional-critical vs. Physical-critical/Emotional-critical

$H_o = \mu_6 = \mu_9$

$H_1 = \mu_6 \neq \mu_9$

D. F. = 39

Critical values $t_{.01} = \pm 2.7$

$t_{.05} = \pm 2.02$

Results.

Mean of Physical-up and Emotional-critical = .2929

Mean of Physical-critical and Emotional-critical = .3059

Variance of Physical-up and Emotional-critical = .1891

Variance of Physical-critical and emotional-critical = .5248

Number of Players in Physical-up and Emotional-critical = 29

Number of Players in Physical-critical and Emotional-critical = 12

$$t = -.0707$$

Since $t < 2.02$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-critical vs.

Physical-critical/Emotional-down

$$H_o = \mu_7 = \mu_8$$

$$H_1 = \mu_7 \neq \mu_8$$

D. F. = 75

Critical values $t_{.01} = \pm 2.64$

$t_{.05} = \pm 1.99$

Results.

Mean of Physical-down and Emotional-critical	= .2920
Mean of Physical-critical and Emotional-down	= .3723
Variance of Physical-down and Emotional-critical	= .1693
Variance of Physical-critical and Emotional-down	= .1486
Number of Players in Physical-down and Emotional-critical	= 35
Number of Players in Physical-critical and Emotional-down	= 42

$$t = -.8818$$

Since $t < 1.99$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-down/Emotional-critical vs.

Physical-critical/Emotional-critical

$$H_o = \mu_7 = \mu_9$$

$$H_1 = \mu_7 \neq \mu_9$$

D. F. = 45

Critical values $t_{.01} = \pm 2.69$

$t_{.05} = \pm 2.015$

Results.

Mean of Physical-down and Emotional-critical = .2920

Mean of Physical-critical and Emotional-critical = .3059

Variance of Physical-down and Emotional-critical = .1693

Variance of Physical-critical and Emotional-critical = .5248

Number of Players in Physical-down and Emotional-critical = 35

Number of Players in Physical-critical and Emotional-critical = 12

$t = -.0817$

Since $t < 2.01$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Physical-critical/Emotional-down vs.
Physical-critical/Emotional-critical

$H_o = \mu_8 = \mu_9$

$H_1 = \mu_8 \neq \mu_9$

D. F. = 52

Critical values $t_{.01} = \pm 2.67$

$t_{.05} = \pm 2.009$

Results.

Mean of Physical-critical and Emotional-down = .3723

Mean of Physical-critical and Emotional-critical = .3059

Variance of Physical-critical and Emotional-down = .1486

Variance of Physical-critical and Emotional-critical = .5248

Number of Players in Physical-critical and Emotional-down = 42

Number of Players in Physical-critical and Emotional-critical = 12

$$t = .4246$$

Since $t < 2.00$, the null hypothesis was accepted which stated there was no difference in the means of these two categories.

Table IV presents a concise summation of the results of the t-tests. An asterisk has identified each t-test where there was a significant difference at the .05 level of confidence.

Summary

The analysis of variance indicated there were significant differences among the categories. Therefore, t-tests were performed on each pair of categories to determine where the differences existed. The results of the t-tests indicated that significant differences occurred when category IV, Physical-down/Emotional-down was compared to category V, Physical-critical/Emotional-up, and in four instances when category VIII, Physical-critical/Emotional-down was compared to category I, Physical-up/Emotional-up, category II, Physical-up/Emotional-down, category III, Physical-down/Emotional-up, and with category IV, Physical-down/Emotional-down. In each of these instances it was necessary to reject the null hypothesis and to acknowledge that significant differences had occurred.

On the basis of the review of literature that was documented concerning the biorhythm cycles and, in particular, the importance of the

TABLE IV

SUMMATION OF t-TESTS

	I	II	III	IV	V	VI	VII	VIII	IX
Cat. I	X	.7571	.9403	1.6153	-1.6138	-1.3066	-1.3686	-3.2737*	-.9690
II	.7571	X	.2618	.92628	-1.8543	-1.4825	-1.5645	-3.3409*	-1.0691
III	.9403		X	.6337	-1.8876	-1.5077	-1.6002	-3.2869*	-1.0806
IV	1.6153			X	-2.2127*	-1.7497	-1.8644	-3.4889*	-1.2266
V	-1.6138				X	-.0620	-.0553	-1.1457	-.1332
VI	-1.3065					X	.0085	-.8087	-.0707
VII	-1.3636						X	-.8818	-.0817
VIII	-3.2737							X	.4246
IX	-.9690								X

critical phase when it crosses the neutral line, there appeared to be an analogy between the review of literature and the results of the t-tests. Is there something particularly unique about the critical phase of a cycle more so than either the up or down phases? Although it was not a part of this study, was it uniquely important to recognize the ascending and descending phases of each cycle as they approached the zero or neutral line?

The literature presented the concept that the critical phase of the biorhythm cycle may be the time for difficulties. The results of this study, based on the mean of probabilities, indicated that periods of the best foul shooting occurred during the critical phase. This factor was substantiated in the information summarized in Table III, Summation of Descriptive Statistics for Each Category. The mean of probabilities was the highest in categories VI, VII, VIII, and IX when at least one phase was in a critical state. Did these results occur merely by chance or was there some other unknown factor that caused these results to occur? It seems evident that a coach should remain aware of the biorhythmic status of each player who is going through a critical phase, for contrary to current biorhythm theory, the athlete may perform better under game conditions.

Would further investigations identify significant differences with other categories? It seems reasonable to conclude there is a need for more research. Other investigations into this biological phenomenon should be completed; this information should be documented concerning the effect of these long-term rhythms on human performance; other tests should be performed to determine if there is a valid relationship between biorhythmic cycles and human performance in various athletic events.

Finally, it appears that on the basis of the results of this study, the 23-day physical and 28-day emotional biorhythm cycles had an effect on basketball free throw shooting. It was documented in Table III that the best foul shooting occurred during the categories when at least one phase was in a critical state. Were these results in occurrence by chance or was there some other unknown factor involved?

Looking at individual free throw probabilities for each of the nine categories, some athletes had relatively higher performances on some cycles that the literature considers advantageous but the majority of the athletes did more poorly under these same categories. A long range individual study might determine a trend of performance which would vary from one individual to another. In a sport such as basketball when many games are won or lost by a single basket, this knowledge could be the edge a coach needs to increase his win-loss record.

It may be of some value to the coach, and perhaps it may give him that slight edge, to be aware of the biorhythmic status of his players for the course of the season. This awareness may help the coach to utilize the talents and efforts of his players to their maximum capabilities. For example, the biorhythm status of the player may not affect his shooting ability; however, a player who is experiencing a critical state in at least one phase of the biorhythmic cycles may be apt to suffer more quickly from physical fatigue and may benefit from more frequent periods of rest.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

During the past two decades, a considerable amount of information has been developed concerning the controversial biorhythm cycle. This concept suggests the existence of three long-term rhythms: the 23-day physical cycle, the 28-day emotional cycle, and the 33-day intellectual cycle. There have been numerous articles published and a number of books written concerning these rhythms. While it appears that some of the information may be speculative, there has emerged from this research a group of believers in this biological phenomenon.

The theory indicates that three long-term rhythms may influence human performance. If this is true, it could have a significant effect on those persons involved with sports. Training programs could be adapted to an athlete's biorhythm cycle. Coaches would be inclined to present a player lineup for competition based upon the biorhythm status of each member of his team.

A review of literature was completed in an attempt to understand the underlying principles concerning biorhythms. It presented a premise that some people accepted this theory and that others completely disclaimed the validity of long-term body rhythms whose origin was based upon a person's birthdate.

The purpose of this study was to determine if a relationship existed between human performance under game conditions and the 23-day physical and the 28-day emotional biorhythmic cycle.

The subjects for this study included 91 varsity basketball players from selected colleges and universities. They played during the 1977-78 basketball season. When their respective biorhythm charts were prepared, no attempt was made to calculate the exact time of birth. The charts were developed solely from the respective birthdate of each subject.

An analysis of variance was used to determine if there were variations between any of the categories. Since some differences did exist, t-tests were performed on each pair of categories to determine where the differences existed. The t-tests were statistically analyzed at the .05 level of confidence.

Findings

Using the .05 level of confidence, the findings for this study were as follows:

1. When an analysis of variance was run on the total number of scores to identify any variations occurring between the categories, there was an indication that the scores differed by some degree among the nine categories. Therefore, t-tests were performed on each pair of categories to determine where the differences existed.

2. The calculations from the t-tests provided the following information:

    a. With one exception, there were no significant differences when the categories I, II, III, IV, V, VI, VII, and IX were compared.

b. When the t-tests were performed between category IV, Physical-down/Emotional-down, and category V, Physical-critical/Emotional-up, there was a significant difference at the .05 level of confidence.

c. The t-tests at the .01 level of confidence indicated a significant difference between category I, Physical-up/Emotional-up, and category VIII, Physical-critical/Emotional-down. The mean of the probabilities of free throws made during category I was .227 as compared to category VIII, which was .372.

d. The t-tests at the .01 level of confidence indicated a significant difference between category II, Physical-up/Emotional-down, and category VIII, Physical-critical/Emotional-down. The mean of the probabilities of free throws made during category II was .211 as compared to category VIII, which was .372.

e. The t-tests at the .01 level of confidence indicated a significant difference between category III, Physical-down/Emotional-up, and category VIII, Physical-critical/Emotional-down. The mean of the probabilities during category III was .204 as compared to category VII, which was .372.

f. The t-tests at the .01 and .05 level of confidence indicated a significant difference between category IV, Physical-down/Emotional-down, and category VIII, Physical-critical/Emotional-down. The mean of the probabilities during category IV was .183 as compared to category VIII, which was .372.

As a result of the statistical calculations, it appeared that categories V, VI, VII, VIII, and IX were areas worthy of further study concerning the relationship between biorhythms and athletic performance.

In repeated instances these categories registered a significant difference with the other categories.

Contrary to what the review of current literature indicated concerning a critical state, the best foul shooting occurred during this period of time. This is substantiated in Table III, Summation of Descriptive Statistics for Each Category, in the section covering the Mean of the Probabilities.

Conclusions

The literature indicated that the relationship between biorhythm cycles and human performance cannot be ignored. There has been an abundance of information documented concerning the relationship of biorhythms to medicine, the best time for elective surgery, industrial accidents, and vehicular accidents. To date, there have been limited investigations concerning this biological phenomenon as it relates to athletic performance.

The results of this study indicated that there was a relationship between the physical and emotional biorhythmic cycles and human performance. It would seem appropriate that research should be continued to evaluate these rhythms in order to ascertain if an accurate measurement could be made to determine the level of relationship between the biorhythm cycles and human performance.

Based upon the results of this study, the following conclusion is: irrespective of the current research concerning biorhythms and human performance, foul shooting was superior during four categories of the biorhythm cycles when at least one phase of each category was in a critical state.

Recommendations

It seems evident that a relationship may exist between athletic performance and biorhythms. To date, there has been a limited number of scientific studies to validate this relationship. On the basis of the completion of this research, the following recommendations are:

1. Consideration should be given to the utilization of a longitudinal study specific to this subject. Research projected for a several-year period could indicate some other results that may produce more information concerning the relationship between biorhythmic cycles and human performance. It is possible that these cycles may affect some person more than others or that the cycle may vary in the number of days from one person to another.

2. More subjects should be considered for the study.

3. A minimum number of foul shots executed during the entire season should be established before a calculation is completed on any subject.

4. The foul shot in basketball should be the athletic skill investigated. This skill offers the most consistency in terms of variables that must be controlled.

5. The investigation should consider the ascending and descending phases of the respective cycles as the final calculations are being completed.

6. The biorhythmic calculations should consider the exact time of birth. This factor may have some effect on the structure of the biorhythm cycles.

7. Biorhythms should be checked for those who were playing in an attempt to determine when a player was pulled from a game for doing

poorly. A similar check should be made to identify apparent illness, missed games, and not starting or playing.

8. Since this biological phenomenon is subject to so much controversy, more detailed and scientific research should be completed. Other forms of physical skills and sports skills should be considered for investigation to determine if there is a significant relationship between athletic performance and the 23-day physical and the 28-day emotional biorhythmic cycles.

9. Have daily practice games and keep all players in for the duration of the game in order to achieve the same proportionate number of games as there are days in each of the nine categories in the biorhythm cycle. This would potentially increase the number of free throw attempts during the double critical category. Since category IX occurs very seldom, chances for this category to fall on a game day usually produces a small number of free shot sttempts. This small sample size could distort the means of probabilities either positively or negatively.

SELECTED BIBLIOGRAPHY

1. Aschoff, Jurgen. Circadian Clocks. Amsterdam: North-Holland, 1965.

2. Bates, Corey and Phil Heit. "Prevention Through Biorhythms." Health Education, Vol. 9, No. 2 (March/April, 1978), pp. 37-38.

3. Bigham, Barbara. "How to Put Biorhythms to Work on Blues." Writers Digest, Vol. 55, No. 8 (August, 1975), p. 14-15.

4. Bolch, Jennifer. "A Key to Your Ups and Downs." Readers Digest (September, 1977), p. 63-67.

5. Bunning, Erwin. The Psychological Clock. New York: Springer-Verlag, 1967.

6. Cawiezel, Selen L. "An Investigation of the Effect of the Physical Biorhythm on Skill Performance." (Master's thesis in Education, Chadron State College, Nebraska, 1977.)

7. Chan, Janet. "Biorhythms, Charting Your Ups and Downs." McCalls, Vol. 105, No. 7 (April, 1978), p. 56.

8. Dale, Arbie. Biorhythms. New York: Kangaroo Books, Pocket Books Publishing Co., 1977.

9. Daily Oklahoman, Thursday, July 13, 1978, p. 53.

10. Gittelson, Bernard. Biorhythms - A Personal Science. New York: Warner Communication Co., 1978.

11. Gittelson, Bernard. Biorhythm Sports Forecasting. New York: Arco Publishing Co., 1977.

12. Gittelson, Bernard. National Observer, Dec. 7, 1979, p. 1, Col. 1-6.

13. Halbrugge, Theodor. "The Development of Circadian Rhythms in Infants." Symposia on Quantitative Biology, Cold Springs Harbor, 1960, pp. 311-323.

14. Khalil, Tarek M. and Charles N. Kurucz. "The Influence of Biorhythms on Accident Occurrence and Performance." Ergonomics, Vol. 20, No. 4 (November 4, 1977), pp. 389-398.

15. Kleitman, N. and A. Doktorsky, "Periodicity in Body Temperature and Rectal Temperature in Man." The Psychological Review (January, 1933), pp. 340-343.

16. Krause-Poray, B. J. Biorhythm in Sports. Brisbane, Australia: Biorhythm Research and Information Centre, 1974.

17. Lobban, Mary C. "The Entertainment of Circadian Rhythms in Man." Symposia on Quantitative Biology, Cold Springs Harbor, 1960, pp. 325-332.

18. Louis, Arthur M. "Should You Buy Biorhythms?" Psychology Today (April, 1978), p. 93-96.

19. Luce, Gay G. "Biological Clocks." Today's Education (October, 1971), pp. 40-63.

20. Luce, Gay G. Biological Rhythms in Psychiatry and Medicine. Chevy Chase, Maryland: National Institute for Mental Health, U. S. Department of Health, Education and Welfare, 1970.

21. Mackenzie, Jean. "How Biorhythms Affects Your Life." Science Digest, Vol. 74, No. 2 (August, 1973), pp. 18-22.

22. Mills, J. N. "Human Circadian Rhythms." The Physiological Review, (January, 1966), p. 128.

23. Moss, R. H. and others. "Fluctuations in Symptoms and Moods During the Menstrual Cycle." Journal of Psychosomatic Research, Vol. 13 (March, 1969), pp. 37-44.

24. Nance, Richard Michael. "An Examination of the 23-Day Theory of Biological Timing to Motor Performance and Motor Proficiency." (Unpublished doctoral dissertation, University of Maryland, 1976.)

25. Nelson, Ed. "New Facts on Biorhythms." Science Digest, Vol. 79, No. 5 (May, 1976), pp. 70-75.

26. O'Neil, Barbara and Richard Phillips. Biorhythms - How to Live with Your Life Cycles. Pasadena, California: Ritchie Press, 1975.

27. Parlee, M. B. "The Rhythms in Men's Lives." Psychology Today, Vol. 11, No. 11 (April, 1978), pp. 82-91.

28. Reams, Curtis L. "The Effects of the 23-Day and 28-Day Biorhythm Cycles on Human Performance." (Unpublished doctoral dissertation for the Doctor of Education, Oklahoma State University, 1978.)

29. Sachs, Michael L. "Biorhythms and Athletic Performance." (Unpublished doctoral dissertation for the Doctor of Education, Florida State University, 1977.)

30. Thommen, George. Is This Your Day. New York: Crown Publishers, 1973.

31. Wallerstein, R. Michael and Nancy Lee Roberts. "All Together on the Bio-Curve." Human Behavior (April, 1973), pp. 8-15.

32. Washington Post, Feb. 2, 1975, Sec. I, p. 4, Col. 1-6.

33. Washington Post, May 23, 1975, Sec. C, p. 1, Col. 1-4.

34. Willis, R. Harold. "Biorhythms and Its Relationship to Human Error." (Paper presented to the 16th annual meeting of the Human Factors Society, Inc., P. O. Box 1369, Santa Monica, California, 90406.)

APPENDIX A

LETTER OF REQUEST FOR SUBJECT INFORMATION

September 1, 1978

Mr. George Hauser
Basketball Coach
Southwestern State University
Weatherford, OK

Hello George,

I trust this letter finds you well and getting ready for another successful basketball season. George, it is concerning basketball that I contact you.

At the present, I am on a sabbatical leave for this semester to O.S.U. for the purpose of completing a residency and to get my dissertation proposal completed. My study is to do a research project on the effects of biorhythms on free throw accuracy. As you know, biorhythms is getting some publicity concerning athletic performance. What I need from you is the following:

1. The names and birthdates of your playing personnel from last year, the 1977-78 season.
2. A copy of each game played from your scorebook plus the date the game was played. If the date is not entered in the book, send an old schedule.

George, I know that you and your S.I.D. are about ready to get quite busy. If you don't have the time, could you send me your scorebook in order that I may duplicate the records from each game played. I will pay for all postage, assure you of good care of your book, and return it by registered mail.

In return for this assistance, I will provide you with a copy of my results. It will be interesting to note if there is any biorhythm effect on free throw performance. Although the testing will incorporate information from a previous season, the process would be the same and be applicable at any time.

George, I would really appreciate your help specific to this and trust that I may hear from you in the near future. Your cooperative efforts may help provide some fresh insights on basketball performance.

Professionally yours,

Hal Weisbein
Associate Professor, HPER
University of Science and Arts of Oklahoma

Please send information to: 1317 California St., Chickasha, OK 73018.

HW/je

APPENDIX B

SAMPLE BIORHYTHM CHART

SAMPLE BIORHYTHMIC CHART

DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL
1	6.31	7.81	9	-9.97	4.33	17	5.19	-9.74	25	3.98	-0.00
2	3.98	9.00	10	-9.79	2.22	18	7.30	-10.00	26	1.36	2.22
3	1.36	9.74	11	-8.87	0.00	19	8.87	-9.74	27	-1.36	4.33
4	-1.36	10.00	12	-7.30	-2.22	20	9.79	-9.00	28	-3.98	6.23
5	-3.98	9.74	13	-5.19	-4.33	21	9.97	-7.81	29	-6.31	7.81
6	-6.31	9.00	14	-2.69	-6.23	22	9.42	-6.23	30	-8.16	9.00
7	-8.16	7.81	15	-0.00	-7.81	23	8.16	-4.33			
8	-9.42	6.23	16	2.69	-9.00	24	6.31	-2.22			

MONTH OF DEC.

DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL
1	-9.42	9.74	9	2.69	0.00	17	6.31	-9.74	25	-9.97	4.33
2	-9.97	10.00	10	5.19	-2.22	18	3.98	-9.00	26	-9.79	6.23
3	-9.79	9.74	11	7.30	-4.33	19	1.36	-7.81	27	-8.87	7.81
4	-8.87	9.00	12	8.87	-6.23	20	-1.36	-6.23	28	-7.30	9.00
5	-7.30	7.81	13	9.79	-7.81	21	-3.98	-4.33	29	-5.19	9.74
6	-5.19	6.23	14	9.97	-9.00	22	-6.31	-2.22	30	-2.69	10.00
7	-2.69	4.33	15	9.42	-9.74	23	-8.16	-0.00	31	-0.00	9.74
8	-0.00	2.22	16	8.17	-10.00	24	-9.42	2.22			

MONTH OF JAN.

DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL
1	2.69	9.00	9	6.31	-6.23	17	-9.97	-6.23	25	5.19	9.00
2	5.19	7.81	10	3.98	-7.81	18	-9.79	-4.33	26	7.30	9.74
3	7.30	6.23	11	1.36	-9.00	19	-8.87	-2.22	27	8.87	10.00
4	8.87	4.33	12	-1.36	-9.74	20	-7.30	-0.00	28	9.79	9.74
5	9.79	2.22	13	-3.98	-10.00	21	-5.19	2.22	29	9.97	9.01
6	9.97	0.00	14	-6.31	-9.74	22	-2.69	4.33	30	9.42	7.81
7	9.42	-2.22	15	-8.16	-9.01	23	-0.00	6.23	31	8.17	6.23
8	8.17	-4.33	16	-9.42	-7.81	24	2.69	7.81			

MONTH OF FEB.

DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL
1	6.31	4.33	9	-9.97	-9.74	17	5.19	-0.00	25	3.98	9.74
2	3.98	2.22	10	-9.79	-10.00	18	7.30	2.22	26	1.36	9.01
3	1.36	0.00	11	-8.87	-9.74	19	8.87	4.33	27	-1.36	7.81
4	-1.36	-2.22	12	-7.30	-9.01	20	9.79	6.23	28	-3.98	6.23
5	-3.98	-4.33	13	-5.19	-7.81	21	9.97	7.81			
6	-6.30	-6.23	14	-2.69	-6.23	22	9.42	9.00			
7	-8.16	-7.81	15	-0.00	-4.33	23	8.17	9.74			
8	-9.42	-9.00	16	2.69	-2.22	24	6.31	10.00			

MONTH OF MAR.

DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL	DAY	PHYSICAL	EMOTIONAL
1	-6.30	4.33	9	-2.69	-9.74	17	9.42	-0.00	25	-8.16	9.74
2	-8.16	2.22	10	-0.00	-10.00	18	8.17	2.22	26	-9.42	9.01
3	-9.42	0.00	11	2.69	-9.74	19	6.31	4.33	27	-9.97	7.81
4	-9.97	-2.22	12	5.19	-9.01	20	3.98	6.23	28	-9.79	6.23
5	-9.79	-4.33	13	7.30	-7.81	21	1.36	7.81	29	-8.87	4.34
6	-8.87	-6.23	14	8.87	-6.23	22	-1.35	9.00	30	-7.30	2.22
7	-7.30	-7.81	15	9.79	-4.34	23	-3.98	9.74	31	-5.19	0.00
8	-5.19	-9.00	16	9.97	-2.22	24	-6.30	10.00			

APPENDIX C

TABLES

TABLE V

NUMBER OF FREE THROWS MADE DURING EACH PHASE OF THE BIORHYTHMIC CYCLE

CATEGORY I: PHYSICAL-UP, EMOTIONAL-UP
CATEGORY II: PHYSICAL-UP, EMOTIONAL-DOWN
CATEGORY III: PHYSICAL-DOWN, EMOTIONAL-UP
CATEGORY IV: PHYSICAL-DOWN, EMOTIONAL-DOWN
CATEGORY V: PHYSICAL-CRITICAL, EMOTIONAL-UP
CATEGORY VI: PHYSICAL-UP, EMOTIONAL-CRITICAL
CATEGORY VII: PHYSICAL-DOWN, EMOTIONAL-CRITICAL
CATEGORY VIII: PHYSICAL-CRITICAL, EMOTIONAL-DOWN
CATEGORY IX: PHYSICAL-CRITICAL, EMOTIONAL-CRITICAL
CATEGORY X: TOTAL FREE THROWS MADE AND ATTEMPTED

SUBJECT	I	II	III	IV	V	VI	VII	VIII	IX	X
1	38/55	11/17	17/22	63/80	4/ 7	0/ 0	0/ 0	0/ 0	0/ 0	133/181
2	10/11	4/ 9	12/16	4/ 6	9/ 9	1/ 1	2/ 4	0/ 0	0/ 0	42/ 56
3	22/26	21/31	17/25	16/35	0/ 0	2/ 3	0/ 0	2/ 3	0/ 0	80/123
4	13/20	3/ 3	20/30	20/27	6/10	0/ 0	0/ 0	0/ 0	0/ 0	62/ 90
5	6/ 9	25/31	13/23	10/18	1/ 2	3/ 4	1/ 3	3/ 4	0/ 0	62/ 94
6	15/23	12/16	1/ 4	2/ 2	0/ 0	0/ 2	2/ 5	0/ 0	0/ 0	32/ 52
7	15/23	3/ 8	6/ 9	17/21	0/ 0	2/ 2	0/ 0	0/ 0	0/ 0	43/ 63
8	8/11	4/ 5	6/14	11/16	3/ 4	5/ 5	2/ 9	0/ 0	0/ 3	39/ 67
9	2/ 4	0/ 0	7/11	8/13	0/ 2	5/ 8	0/ 0	0/ 0	0/ 0	22/ 38
10	36/40	19/24	30/38	56/69	12/15	0/ 0	6/ 7	4/ 5	0/ 0	163/198
11	6/ 9	6/ 8	8/13	14/16	0/ 0	0/ 0	0/ 0	6/ 6	0/ 0	40/ 52
12	10/14	13/19	17/22	15/22	0/ 0	0/ 0	0/ 0	11/17	0/ 0	66/ 94
13	3/ 4	7/11	11/17	4/ 6	0/ 0	0/ 0	3/ 4	5/ 6	0/ 0	33/ 48
14	8/16	4/13	24/41	12/21	0/ 0	0/ 0	0/ 0	2/ 5	0/ 0	50/ 96
15	5/10	2/ 5	4/ 8	4/ 6	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	15/ 29
16	4/ 4	8/11	6/ 7	11/15	0/ 0	1/ 2	4/ 4	0/ 0	0/ 0	34/ 43
17	2/ 2	5/10	2/ 4	2/ 4	1/ 2	0/ 0	0/ 0	0/ 0	0/ 0	12/ 22
18	12/17	14/20	36/48	18/23	0/ 0	0/ 0	3/ 6	2/ 2	0/ 0	85/116
19	6/14	3/11	9/12	3/ 4	2/ 2	0/ 0	0/ 0	1/ 2	0/ 0	24/ 45
20	16/20	7/12	45/53	31/42	15/17	8/11	8/11	6/ 6	0/ 0	136/172
21	26/37	28/40	27/43	32/52	8/11	0/ 0	12/15	0/ 0	0/ 0	133/198
22	15/21	12/18	13/15	7/ 7	8/12	0/ 0	4/ 4	1/ 2	0/ 0	60/ 79
23	7/14	8/14	17/19	11/17	0/ 0	5/ 5	4/ 4	0/ 0	0/ 0	52/ 73
24	6/ 8	10/15	8/13	11/17	4/ 6	0/ 0	0/ 0	1/ 2	0/ 0	40/ 61
25	9/16	19/30	9/20	12/19	0/ 0	1/ 2	0/ 0	1/ 2	0/ 1	51/ 90
26	7/11	5/ 8	11/16	12/14	0/ 0	1/ 4	0/ 4	0/ 0	0/ 0	36/ 57
27	7/ 9	4/ 5	9/13	1/ 3	6/ 6	0/ 0	0/ 0	10/12	1/ 2	38/ 50
28	4/ 5	2/ 2	1/ 1	0/ 1	4/ 5	3/ 3	2/ 2	0/ 0	0/ 1	16/ 20
29	1/ 3	0/ 0	3/ 4	5/ 7	0/ 0	1/ 4	0/ 0	1/ 1	0/ 0	11/ 19
30	11/17	6/ 9	4/ 5	14/17	3/ 3	0/ 0	2/ 2	0/ 0	0/ 0	40/ 53
31	2/ 4	7/13	5/ 9	12/18	8/10	0/ 0	0/ 0	0/ 0	0/ 0	34/ 54
32	26/29	28/36	14/20	12/14	0/ 0	0/ 0	0/ 0	10/12	0/ 0	90/111
33	10/12	8/13	3/ 6	12/15	2/ 3	0/ 0	0/ 0	0/ 0	0/ 0	35/ 49

TABLE V (Continued)

SUBJECT	I	II	III	IV	V	VI	VII	VIII	IX	X
34	14/22	0/ 1	14/17	3/ 4	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	31/ 44
35	2/ 5	3/ 5	13/24	7/ 8	0/ 0	0/ 0	4/ 7	0/ 0	0/ 0	29/ 49
36	4/ 6	23/24	28/31	0/ 1	0/ 0	2/ 3	0/ 0	0/ 0	0/ 0	57/ 65
37	3/ 4	0/ 1	17/26	7/ 8	5/ 8	1/ 2	1/ 2	0/ 0	2/ 4	36/ 55
38	6/10	1/ 3	9/16	3/ 4	4/ 6	4/ 5	0/ 0	6/ 6	2/ 2	35/ 52
39	2/ 3	8/10	4/ 9	9/14	16/18	0/ 0	0/ 0	0/ 0	0/ 0	39/ 54
40	4/ 5	17/26	20/33	14/24	4/ 6	6/ 7	11/16	0/ 0	0/ 0	76/117
41	20/26	15/25	3/ 3	42/54	0/ 0	0/ 0	7/ 8	7/ 8	0/ 0	94/124
42	1/ 3	17/21	5/ 8	2/ 7	0/ 0	2/ 2	0/ 0	4/ 5	0/ 0	31/ 46
43	5/11	23/35	33/49	1/ 6	0/ 0	0/ 0	0/ 0	1/ 2	0/ 0	63/103
44	0/ 1	5/ 8	11/13	4/ 6	4/ 4	0/ 0	0/ 0	0/ 0	0/ 0	24/ 32
45	4/ 5	4/ 6	4/ 7	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	12/ 18
46	10/11	21/27	25/30	18/20	6/ 6	0/ 0	0/ 0	2/ 4	0/ 0	82/ 98
47	15/18	7/ 9	4/ 7	6/10	8/10	0/ 0	2/ 4	2/ 2	9/ 9	53/ 69
48	39/42	11/12	30/41	42/48	0/ 0	7/10	0/ 0	2/ 2	0/ 0	131/155
49	21/41	29/46	28/43	19/35	0/ 0	3/ 5	3/ 3	3/ 4	0/ 0	106/177
50	22/34	9/13	15/28	12/14	0/ 0	0/ 0	0/ 0	3/ 6	0/ 0	61/ 95
51	7/14	0/ 1	10/23	9/12	3/ 4	4/ 4	0/ 0	2/ 4	0/ 0	35/ 62
52	7/10	7/ 9	4/ 5	19/26	1/ 2	0/ 0	0/ 0	0/ 0	0/ 0	38/ 52
53	4/10	2/ 2	9/11	7/ 9	3/ 4	0/ 0	5/ 6	2/ 2	0/ 0	32/ 44
54	11/17	6/ 8	8/13	10/13	5/ 7	0/ 0	0/ 0	6/ 9	0/ 0	46/ 67
55	5/ 7	16/23	5/ 7	7/13	2/ 4	0/ 0	0/ 0	1/ 2	0/ 0	36/ 56
56	0/ 1	1/ 2	15/21	2/ 3	0/ 2	0/ 0	0/ 0	0/ 0	0/ 0	18/ 29
57	11/15	5/ 8	5/ 8	13/16	0/ 1	0/ 0	0/ 0	2/ 2	0/ 0	36/ 50
58	0/ 2	13/20	3/ 4	0/ 0	0/ 0	0/ 0	0/ 0	1/ 2	0/ 0	17/ 28
59	3/ 3	17/28	1/ 2	17/30	1/ 2	9/11	1/ 2	1/ 3	0/ 0	50/ 81
60	32/44	14/19	30/35	9/17	12/14	11/19	9/13	0/ 0	3/ 4	120/165
61	3/ 6	8/13	2/ 2	5/ 8	4/ 4	0/ 0	0/ 0	3/ 7	0/ 0	25/ 40
62	1/ 4	21/36	12/16	2/ 6	4/ 7	8/ 8	1/ 2	0/ 0	0/ 0	49/ 79
63	7/ 9	9/10	15/18	5/ 8	0/ 0	0/ 0	0/ 0	3/ 4	0/ 0	39/ 49
64	9/10	10/14	9/18	18/21	0/ 0	0/ 0	0/ 1	0/ 0	0/ 0	46/ 64
65	4/ 6	6/10	1/ 2	5/ 9	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	16/ 27
66	4/ 4	8/12	6/ 7	5/ 7	0/ 0	0/ 0	4/ 5	0/ 0	0/ 0	27/ 35
67	2/ 2	0/ 0	6/ 7	3/ 6	10/15	0/ 0	0/ 0	0/ 0	0/ 0	21/ 30
68	5/ 9	32/41	13/18	0/ 0	1/ 2	0/ 0	0/ 0	0/ 1	0/ 0	51/ 71
69	0/ 1	2/ 4	4/ 4	7/ 8	3/ 5	0/ 0	0/ 0	0/ 0	0/ 0	16/ 22
70	4/ 8	11/18	5/12	4/ 7	0/ 0	5/ 7	6/ 7	0/ 0	0/ 0	35/ 59
71	14/25	2/ 2	11/19	13/29	0/ 0	6/10	6/ 8	1/ 1	0/ 0	53/ 94
72	0/ 0	2/ 7	8/ 8	0/ 1	0/ 0	0/ 0	0/ 1	0/ 0	0/ 0	10/ 17
73	11/19	13/19	8/12	18/27	9/13	0/ 0	0/ 0	0/ 0	0/ 0	59/ 90
74	6/ 8	25/32	27/35	13/28	0/ 0	0/ 0	0/ 0	5/ 7	4/ 7	80/117
75	8/16	3/ 4	5/10	9/12	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	25/ 42
76	8/12	4/ 6	2/ 2	8/ 8	2/ 2	4/ 4	0/ 0	0/ 0	0/ 0	28/ 34
77	12/15	2/ 5	5/ 8	10/18	7/ 8	0/ 0	0/ 1	0/ 0	0/ 0	36/ 55
78	1/ 3	9/ 9	9/16	10/15	0/ 0	2/ 2	3/ 5	0/ 0	2/ 3	36/ 53
79	16/22	3/ 4	6/ 9	5/ 7	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	30/ 42
80	5/ 7	0/ 0	3/ 5	4/ 6	3/ 5	0/ 0	0/ 0	1/ 2	0/ 0	16/ 25
81	2/ 4	2/ 4	4/ 6	5/ 9	2/ 3	0/ 0	0/ 0	0/ 0	0/ 0	15/ 26
82	10/16	7/16	17/27	9/21	0/ 0	0/ 0	0/ 0	1/ 3	4/ 5	48/ 88
83	1/ 1	5/ 7	6/ 9	2/ 4	6/ 6	0/ 0	0/ 0	0/ 0	0/ 0	20/ 27
84	7/ 9	17/21	16/24	7/11	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	47/ 65
85	1/ 4	5/ 7	9/15	5/ 9	1/ 5	0/ 0	3/ 3	0/ 0	0/ 0	24/ 43
86	24/29	9/10	13/13	13/20	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	59/ 72
87	16/35	8/11	19/28	45/64	2/ 5	0/ 0	16/22	8/12	0/ 0	114/177
88	1/ 2	5/10	9/12	5/ 8	3/ 5	0/ 0	0/ 0	2/ 3	2/ 3	27/ 43
89	4/ 4	7/10	14/15	30/37	6/ 7	0/ 0	0/ 0	0/ 0	0/ 0	61/ 73
90	8/10	1/ 6	13/20	8/13	0/ 0	0/ 0	0/ 0	2/ 3	0/ 0	32/ 52
91	7/ 9	8/10	9/13	16/24	0/ 0	0/ 0	2/ 2	0/ 0	0/ 0	42/ 58

TABLE VI

PROBABILITIES FOR FREE THROWS MADE DURING EACH PHASE OF THE BIORHYTHMIC CYCLE

CATEGORY I: PHYSICAL-UP, EMOTIONAL-UP
CATEGORY II: PHYSICAL-UP, EMOTIONAL-DOWN
CATEGORY III: PHYSICAL-DOWN, EMOTIONAL-UP
CATEGORY IV: PHYSICAL-DOWN, EMOTIONAL-DOWN
CATEGORY V: PHYSICAL-CRITICAL, EMOTIONAL-UP
CATEGORY VI: PHYSICAL-UP, EMOTIONAL-CRITICAL
CATEGORY VII: PHYSICAL-DOWN, EMOTIONAL-CRITICAL
CATEGORY VIII: PHYSICAL-CRITICAL, EMOTIONAL-DOWN
CATEGORY IX: PHYSICAL-CRITICAL, EMOTIONAL-CRITICAL
CATEGORY X: TOTAL FREE THROWS MADE AND ATTEMPTED

SUBJECT	I	II	III	IV	V	VI	VII	VIII	IX	X
1	0.089	0.145	0.183	0.060	0.190	1.000	1.000	1.000	1.000	0.735
2	0.155	0.039	0.225	0.297	0.075	0.750	0.211	1.000	1.000	0.750
3	0.017	0.144	0.161	0.009	1.000	0.444	1.000	0.444	1.000	0.650
4	0.172	0.327	0.148	0.145	0.210	1.000	1.000	1.000	1.000	0.689
5	0.273	0.035	0.107	0.123	0.449	0.391	0.229	0.391	1.000	0.660
6	0.161	0.117	0.140	0.379	1.000	0.148	0.215	1.000	1.000	0.615
7	0.164	0.057	0.272	0.092	1.000	0.466	1.000	1.000	1.000	0.683
8	0.159	0.240	0.109	0.145	0.330	0.067	0.027	1.000	0.073	0.582
9	0.357	1.000	0.226	0.215	0.177	0.272	1.000	1.000	1.000	0.579
10	0.081	0.182	0.136	0.118	0.243	1.000	0.385	0.406	1.000	0.823
11	0.214	0.309	0.103	0.162	1.000	1.000	1.000	0.207	1.000	0.769
12	0.229	0.191	0.151	0.176	1.000	1.000	1.000	0.177	1.000	0.702
13	0.406	0.228	0.187	0.327	1.000	1.000	0.406	0.288	1.000	0.688
14	0.194	0.070	0.089	0.156	1.000	1.000	1.000	0.298	1.000	0.521
15	0.245	0.301	0.272	0.250	1.000	1.000	1.000	1.000	1.000	0.517
16	0.391	0.231	0.358	0.198	1.000	0.331	0.391	1.000	1.000	0.791
17	0.298	0.236	0.369	0.369	0.496	1.000	1.000	1.000	1.000	0.545
18	0.202	0.182	0.127	0.170	1.000	1.000	0.150	0.537	1.000	0.733
19	0.155	0.056	0.078	0.283	0.284	1.000	1.000	0.498	1.000	0.533
20	0.217	0.061	0.084	0.100	0.176	0.231	0.231	0.244	1.000	0.791
21	0.131	0.127	0.104	0.079	0.242	1.000	0.136	1.000	1.000	0.672
22	0.169	0.132	0.170	0.146	0.183	1.000	0.333	0.365	1.000	0.759
23	0.052	0.113	0.044	0.168	1.000	0.183	0.257	1.000	1.000	0.712
24	0.264	0.213	0.213	0.199	0.329	1.000	1.000	0.451	1.000	0.656
25	0.198	0.114	0.102	0.158	1.000	0.491	1.000	0.491	0.433	0.567
26	0.244	0.281	0.189	0.050	1.000	0.126	0.018	1.000	1.000	0.632
27	0.304	0.400	0.201	0.131	0.193	1.000	1.000	0.244	0.365	0.760
28	0.410	0.640	0.800	0.200	0.410	0.512	0.640	1.000	0.200	0.800
29	0.308	1.000	0.327	0.242	1.000	0.173	1.000	0.579	1.000	0.579
30	0.122	0.229	0.398	0.195	0.430	1.000	0.570	1.000	1.000	0.755
31	0.326	0.174	0.235	0.186	0.152	1.000	1.000	1.000	1.000	0.630
32	0.106	0.140	0.094	0.263	1.000	1.000	1.000	0.290	1.000	0.811
33	0.186	0.166	0.170	0.187	0.437	1.000	1.000	1.000	1.000	0.714

TABLE VI (Continued)

SUBJECT	I	II	III	IV	V	VI	VII	VIII	IX	X
34	0.138	0.295	0.130	0.413	1.000	1.000	1.000	1.000	1.000	0.705
35	0.238	0.345	0.143	0.083	1.000	1.000	0.292	1.000	1.000	0.592
36	0.134	0.144	0.212	0.123	1.000	0.284	1.000	1.000	1.000	0.877
37	0.387	0.345	0.163	0.142	0.277	0.452	0.452	1.000	0.307	0.655
38	0.223	0.216	0.129	0.399	0.329	0.335	1.000	0.093	0.453	0.673
39	0.435	0.257	0.057	0.177	0.065	1.000	1.000	1.000	1.000	0.722
40	0.312	0.162	0.123	0.130	0.328	0.184	0.201	1.000	1.000	0.650
41	0.181	0.035	0.436	0.122	1.000	1.000	0.278	0.278	1.000	0.758
42	0.215	0.083	0.270	0.035	1.000	0.454	1.000	0.336	1.000	0.674
43	0.136	0.121	0.081	0.032	1.000	1.000	1.000	0.475	1.000	0.612
44	0.250	0.208	0.206	0.297	0.316	1.000	1.000	1.000	1.000	0.750
45	0.329	0.329	0.256	1.000	1.000	1.000	1.000	1.000	1.000	0.667
46	0.302	0.133	0.192	0.205	0.343	1.000	1.000	0.112	1.000	0.837
47	0.194	0.305	0.152	0.125	0.293	1.000	0.190	0.590	0.093	0.768
48	0.060	0.292	0.025	0.144	1.000	0.137	1.000	0.714	1.000	0.845
49	0.066	0.110	0.099	0.107	1.000	0.346	0.215	0.345	1.000	0.599
50	0.142	0.218	0.077	0.057	1.000	1.000	1.000	0.243	1.000	0.642
51	0.186	0.435	0.076	0.106	0.313	0.102	1.000	0.363	1.000	0.565
52	0.261	0.290	0.384	0.174	0.393	1.000	1.000	1.000	1.000	0.731
53	0.024	0.529	0.233	0.288	0.420	1.000	0.333	0.529	1.000	0.727
54	0.187	0.288	0.192	0.205	0.315	1.000	1.000	0.271	1.000	0.687
55	0.294	0.155	0.294	0.162	0.316	1.000	1.000	0.459	1.000	0.643
56	0.379	0.471	0.126	0.438	0.144	1.000	1.000	1.000	1.000	0.621
57	0.226	0.238	0.238	0.172	0.280	1.000	1.000	0.518	1.000	0.720
58	0.154	0.171	0.352	1.000	1.000	1.000	1.000	0.477	1.000	0.607
59	0.235	0.152	0.472	0.124	0.472	0.105	0.472	0.271	1.000	0.617
60	0.134	0.203	0.035	0.042	0.148	0.070	0.225	1.000	0.420	0.727
61	0.257	0.222	0.391	0.282	0.153	1.000	1.000	0.169	1.000	0.625
62	0.136	0.121	0.123	0.120	0.284	0.022	0.471	1.000	1.000	0.620
63	0.303	0.262	0.226	0.152	1.000	1.000	1.000	0.412	1.000	0.796
64	0.144	0.230	0.027	0.078	1.000	1.000	0.281	1.000	1.000	0.719
65	0.307	0.251	0.483	0.254	1.000	1.000	1.000	1.000	1.000	0.593
66	0.354	0.169	0.337	0.300	1.000	1.000	0.405	1.000	1.000	0.771
67	0.490	1.000	0.247	0.185	0.206	1.000	1.000	1.000	1.000	0.700
68	0.152	0.099	0.206	1.000	0.405	1.000	1.000	0.282	1.000	0.718
69	0.273	0.236	0.280	0.235	0.286	1.000	1.000	1.000	1.000	0.727
70	0.237	0.188	0.107	0.292	1.000	0.255	0.124	1.000	1.000	0.593
71	0.159	0.318	0.181	0.068	1.000	0.244	0.171	0.564	1.000	0.564
72	1.000	0.086	0.014	0.412	1.000	1.000	0.412	1.000	1.000	0.588
73	0.144	0.187	0.238	0.160	0.225	1.000	1.000	1.000	1.000	0.656
74	0.286	0.079	0.082	0.008	1.000	1.000	1.000	0.314	0.242	0.684
75	0.146	0.341	0.205	0.137	1.000	1.000	1.000	1.000	1.000	0.595
76	0.102	0.215	0.678	0.212	0.678	0.460	1.000	1.000	1.000	0.824
77	0.116	0.177	0.277	0.128	0.142	1.000	0.345	1.000	1.000	0.655
78	0.210	0.031	0.123	0.213	1.000	0.461	0.322	1.000	0.444	0.679
79	0.186	0.416	0.260	0.319	1.000	1.000	1.000	1.000	1.000	0.714
80	0.292	1.000	0.340	0.326	0.340	1.000	1.000	0.461	1.000	0.640
81	0.357	0.357	0.297	0.258	0.422	1.000	1.000	1.000	1.000	0.577
82	0.165	0.136	0.106	0.098	1.000	1.000	1.000	0.338	0.201	0.545
83	0.741	0.315	0.242	0.221	0.165	1.000	1.000	1.000	1.000	0.741
84	0.285	0.142	0.142	0.201	1.000	1.000	1.000	1.000	1.000	0.723
85	0.193	0.222	0.196	0.260	0.106	1.000	0.174	1.000	1.000	0.558
86	0.192	0.301	0.075	0.036	1.000	1.000	1.000	1.000	1.000	0.819
87	0.011	0.220	0.148	0.066	0.187	1.000	0.133	0.235	1.000	0.644
88	0.467	0.175	0.172	0.282	0.343	1.000	1.000	0.440	0.440	0.628
89	0.488	0.152	0.200	0.153	0.392	1.000	1.000	1.000	1.000	0.836
90	0.137	0.031	0.175	0.223	1.000	1.000	1.000	0.437	1.000	0.615
91	0.286	0.259	0.227	0.141	1.000	1.000	0.524	1.000	1.000	0.724

VITA 2

Harold Weisbein, Sr.

Candidate for the Degree of

Doctor of Education

Thesis: THE RELATIONSHIP OF THE 23-DAY PHYSICAL AND THE 28-DAY EMOTIONAL BIORHYTHM CYCLES TO FREE THROW ACCURACY

Major Field: Higher Education

Minor Field: Health, Physical Education and Recreation

Biographical:

Personal Data: Born in Philadelphia, Pennsylvania, March 25, 1935, the son of Mr. and Mrs. Jacob Weisbein; married to Margaret Jeane Walser, August 13, 1960; one son Harold, Jr., and two daughters Karen Sue and Pamela Jeane.

Education: Attended the Philadelphia, Pennsylvania, public schools and graduated from John Bartram High School in 1953; received the Bachelor of Science in Health Education degree from West Chester State College in 1957 with a major in Physical Education; received the Master of Science degree with a major in Physical Education from Ohio University in 1962; completed the requirements for the Doctor of Education degree at Oklahoma State University in December, 1980.

Professional Experience: Served as a graduate teaching assistant at Ohio State University, Athens, Ohio, 1957-58 and also served as the assistant varsity soccer coach; taught in the Philadelphia, Pennsylvania, school system as a physical education teacher 1958-59; taught physical education at Chickasha High School, Chickasha, Oklahoma, February, 1961 - May, 1961; taught physical education and served as varsity baseball coach at Clearview Regional High School, Mullica Hill, New Jersey, 1961-67; appointed to the faculty in the HPER Department at the University of Science and Arts of Oklahoma in 1967, now completing 13th year with the present rank of Associate Professor.

Professional Organizations: American Alliance for Health, Physical Education and Recreation; Oklahoma Alliance for Health,

Physical Education and Recreation; Oklahoma Recreation and Parks Society; American Red Cross.

Military Service: Served in the U. S. Army from February 1959 to February 1961.