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Biorhythms and swimming performances

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BIORHYTHMS AND SWIMMING
PERFORMANCES

by

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An Abstract

of a thesis submitted in partial fulfillment
of the requirements for the degree of
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Thesis Advisor: Dr. Harold H. Morris

ABSTRACT

The purpose of this study was to determine the influence of the physical, emotional, and intellectual biorhythmic cycles on the swimming times of age group swimmers. The 81 subjects from the YMCA Winter Competitive Swim Team ranged between six and 17 years of age. The sample included 34 males and 47 females. Each subject that had more than five times for an event had an X/Y graph plotted and a regression line computed using the least-square curve fit. Good and poor performances were selected. Biorhythms for each performance were calculated by the biorhythm computer program.

The frequency of successes for each individual cycle were treated by the Cochran Q test and produced no significant difference. The chi-square test for independence was used to determine what, if any, relationship existed between swimming performance and individual cycles, all possible paired combinations or all three cycles together. No significant relationship was found to exist between swimming performance and individual cycles, all paired combination of cycles, or the three cycles together.

Within the limitations of the study the following conclusions are warranted:

1. Neither positive nor negative cycle positions of the physical; emotional, and intellectual biorhythmic cycles were related to swimming performance.

2. No combination of physical, emotional and intellectual biorhythmic cycles were related to swimming performance.

3. Biorhythmic "critical days" did not influence swimming performance.

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A Thesis Presented to the Faculty of
the School of Health, Physical
Education, and Recreation
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Requirements for the Degree
Master of Science

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by
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Ithaca College
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CERTIFICATE OF APPROVAL

MASTER OF SCIENCE THESIS

This is to certify that the Master of Science Thesis of

Lee Richard Plank

submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Health, Physical Education, and Recreation at Ithaca College has been approved.

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INTRODUCTION

History is a record of man's continuing efforts to improve himself and his environment. Each of man's discoveries and inventions has been a stepping stone to the modern technological society of today. Over the centuries, man has developed a scientific method that enables him to deal with the problems impeding his progress. He has found many different components which effect his performance and receive his attention in the effort to increase industrial efficiency, diminish cultural inequalities, and enhance his social structure.

Coaches and scientists, using a combination of the scientific disciplines, have tried to improve the athlete's performance. Many of the discoveries derived from the application of biomechanics, psychology, and exercise physiology have been employed to further the athlete's efficiency. Track and swimming coaches working together with exercise physiologists have developed training regimes that condition athletes to increasingly higher levels of efficiency. Researchers have sought to reduce the inefficient and ineffective movements and, thereby, increase the efficiency of the athlete through the biomechanical application of physical laws to body structure. Sport psychologists and sociologists have dealt with effects of anxiety, motivation, attitude, and group structure upon individual and team performances. Man, in his continuing effort to improve himself in athletic endeavors, has brought about better quality performances, improved competition, and even greater demands for improvements.

One factor that researchers have found to affect man's general performance is biological cycles. These cyclic patterns have been known to regulate our sleeping patterns, eating habits, body core temperature, taste, smell, and response to medication. These biological cycles, called circadian rhythms, are not generally noticeable to man. He may become aware of their existence only when he crosses several time zones or works rotating shifts. In so doing man's biological rhythms are, thereby, temporarily upset and a period of time is needed to readjust to the new environment. During this readjustment, man may feel hungry for a meal at two o'clock in the morning, or he may feel tired in the middle of a normal working day after a complete night's sleep.

A relationship between biological cycles and patients' illnesses was discovered by two European doctors just prior to the beginning of the twentieth century. Drs. Fliess and Swoboda, a physician and a psychiatrist respectively, both recorded observations about their patients over long periods of time (13,15). Swoboda concentrated on finding a cycle or rhythm to explain a person's emotional cycle of 28 days. He found a 23-day periodicity in fevers, heart attacks, and outbreaks of illnesses in his patients. These findings support the earlier discovery by Fliess of a 23-day physical cycle that governs the occurrence and disappearance of fevers or respiratory problems. Fliess, in his research, traced the origin of the rhythms back to birth. Further research by both Fliess and Swoboda showed that major events such as birth, the onset of illness, heart attacks, and deaths occur on periodic "critical" days.

During the 1920's Alfred Teltscher (15,16), an engineering professor, discovered a third biological rhythm, the intellectual rhythm. Teltscher collected a large number of performance reports on high school and college students at Innsbruck, Germany. The results of Teltscher's statistical sampling disclosed that an exact pattern could be established, and he concluded that the student's high and low peaks of performance fluctuated in a definite 33-day cycle.

All three researchers (15,16) concluded that these cycles operate in such a manner that a person's capacities increase during the first half of each cycle and decline during the second half. Critical days are at the beginning and middle of each cycle. When graphed, a critical day occurs each time the cycle line crosses the x-axis (time continuum). Biorhythms, like many other biological cycles, can be pictured as a linear oscillation or serpential curve about a horizontal axis that represents time. Critical days are the days of least capability in the intellectual cycle when mental mistakes are most likely to occur; in the emotional cycle when the person is most likely to be irritable; in the physical cycle when on the job accidents are most likely to occur (15).

Thus, biological rhythms are another of the many fundamental variables which affect man's performance. For those interested in athletics, it is another in the list of factors to be considered in a sport's training program. Biological cycles can have application in numerous areas of sport. An athlete's position in his biological cycles could affect his strength, training, specific skill, and emotions on a particular day. Biological rhythms would, therefore, govern or influence his effectiveness in an event or contest on a particular day.

Scope of Problem

Various researchers (13,15,16,25) have sought to determine whether biorhythms have any relationship to human performances. Several studies (13,15,16,25) have shown that biological cycles can influence man's athletic performance. In two studies Halberg (26) offered evidence that biological cycles play a large role in the level of adaptation of man to general stress.

Thommen (15:96) explored the concept of biorhythms in sport and illustrated them with numerous case studies. He cited the following example:

> John Uelses, the pole-vaulting Marine, presents another interesting case demonstrating a quick change in an athlete's capability in keeping with changes in his biorhythmic chart. Uelses, an unknown, established a new world record with a pole vault of sixteen feet and one-quarter inch on February 3, 1962, at Madison Square Garden. Never before, outdoors or indoors, has a pole vaulter cleared sixteen feet. This extraordinary feat was somewhat spoiled because an overly zealous photographer accidently bumped the standards supporting the crossbar after Uelses' leap, knocking the bar into the pit. Undaunted by the mishap, Uelses repeated his performance the next night at Boston during the Athletics Association games.
>
> However, two weeks later at Louisville, when Uelses was expected to give another star performance, he failed to clear 14 feet.

Thommen stated that occurrences such as these are possible explanations for the unexpected failures of a champion.

Herring (27) studied swimmers in an attempt to determine if the power of suggestion might be involved in the relationship existing between swimming performances and biorhythms. He found no significant difference between groups and, therefore, ruled out the power of suggestion as a possibility of enchancing biorhythms affect in athletic performances. In looking at the relationship between biorthythms and swimming performances, Herring found a very high relationship between practice performances and biorhythms. In predicting meet performances, however, he found a somewhat lower relationship.

Another of Thommen's (15) examples illustrated the influence of biorhythms in swimming, particularly in the area of championship performances. He presented the possibility that a part of Mark Spitz's outstanding performance during the Olympic games was due to his biorhythmic positions. At the 1972 Olympics, Spitz won seven gold medals and set new world and American records in many of his individual events as well as the relays of which he was a part. During this period (late August-early September), Spitz was in the high part of his physical and emotional rhythms.

Biological cycles have become an accepted fact in science today and have been shown by researchers to influence man's performance. Several researchers (15,17,25) have shown a large number of individual case studies where biorhythms might influence the outcome of an athletic performance. These examples have been examined over a very short period of time either for a single day or possibly four or five days by subjective means. Herring's work (27) is the only study available in the area of athletic performance that considers the effect of biological cycles over a sustained period of time. His results tend to indicate that a relationship does exist between biorhythms and athletic performances.

Statement of Problem

The purpose of this study was to determine the effects of biorhythms upon swimming performances. Specifically, this study attempted to determine the influence of the physical, emotional, and intellectual biorhythmic cycles on the swimming times of age-group swimmers.

Assumptions of the Study

1. In each event the swimmers' capabilities were tested maximally each time they swam.

2. Each meet brought about a true testing of a subject's capabilities.

Definition of Terms

1. Age-Group. Age-group competition consisted of persons between the ages of 6 and 17 years, classified into five age groups: 8 years and under, 9-10 years, 11-12 years, 13-14 years, and 15-17 years.

2. Ithaca YMCA Winter Season. The Ithaca YMCA winter season began the third week in October and ended the fourth week of March.

3. Timing. The elapsed time for the event began at the instant of the flash or smoke from the starter's gun, and ended immediately when, in the opinion of the timer, any part of the swimmer's body touched the wall of the pool.

4. Biological Cycle. A biologically recurring event is conceived as a circular process that started from a point of origin and returned to it.

5. Biorhythms. Biorhythms are regulated frequencies of cycles forming two patterns, the high and low periods, and days of instability called "critical" days.

6. Critical Days. Critical days are known as those days when the physical, emotional, or the intellectual cycles change from high to low, or low to high.

7. Sine Curve. Sine curve is the graph in rectangular coordinates of the equation Y = A sin BX where A and B are constants that when A = 1 and B = 1 pass the origin. All points on the x-axis where the abscissas are multiples of Pi radians. The curve is concave towards the x-axis, and has maximum and minimum ordinates values of +1 and -1.

8. X-axis. The axis of abscissas in a plane Cartesian coordinate system, acts as the time line (continuum) for biological cycles.

Delimitations of Study

1. This study involved only those age-group swimmers participating in the 1973 and 1974 Ithaca YMCA winter competitive swim program.

2. The calculation device was limited to those procedures given by Thommen and Wernli (15,16).

3. Performances used in this investigation were official elapsed times in open events and coaches' records of splits from relays.

4. The best and poorest performances were determined by distance from the regression line of individual swimming performances.

5. The three biological cycles used in this study were those described by Thommen and Wernli (15,16).

6. During the 1973 season, each swimmer was limited to a maximum of three events in dual meet competition and championship competition.

7. During the 1974 season, each swimmer was limited to a maximum of three events in dual meet competition and five events in championship competition.

Limitations of Study

1. All age-group swimmers did not compete in every meet or in the same event every meet due to the coach's decision.

2. Times were dependent on the accuracy and consistency of those persons serving as timers at each meet.

Chapter 2

REVIEW OF RELATED LITERATURE

For the purpose of this chapter the review of related literature has been presented under the following subtopics: (1) biological cycles, (2) biorhythms research, (3) applications of biorhythms, and (4) summary.

Biological Cycles

Before 500 B.C. the ancient people of the eastern culture accepted cycles in life as a basic part of their life. The conception of time found in the eastern culture was based on a past, a present, and a future, which flowed in a continuous circle. In the western culture time is considered as linear with an absolute beginning, present, and end. This cultural difference would explain much of the resistance western man has had in discussing cycles, an example being biological rhythms.

Biological rhythms were recorded by western scientists during the time of Hippocrates, 2400 years ago. Early Greek physicians used cycles of treatments, known as metayncrasis, in treating their patients. Hippocrates is said to have told his students and associates that regularity was a sign of health. Believing that irregular body functions or habits promoted an unsalutary condition, Hippocrates advised fellow physicians and students to look for fluctuations in their patient's symptons and to watch for both good and bad days in their patients and in healthy people. Yet, it was not until the seventeenth century that western researchers were again to become interested in biological cycles.

Sanctorius, a seventeenth century physician, was the first person to record biological cycles in humans. Using a fine scale to weigh healthy men over long periods of time, Sanctorius sought to determine whether or not his male patients had a cycle analogous to the female menstrual cycle. His findings showed that normal men underwent a pronounced one to two pound change each month (8).

Between the years 1928 and 1932, Drs. Hersey and Bennett of the University of Pennsylvania researched the idea of cycles in industrial workers and together found a normal cycle length between 33 and 36 days. These long undulations in emotional and psychological changes were the result of questioning the workers four times a day, for two 10-week periods. They further concluded that variations from the 33-day cycle were largely caused by unusual thyroid activity. No difference was found in cycle length between men and women or any relationship between the menstrual cycle and the 33-day cycle (5).

Psychiatric hospitals such as the Institute of Living, Hartford, Connecticut, have begun to analyze day to day staff notes on patients by computer. The data collected have shown definite periodic mood shifts that had previously passed unnoticed, simply because they had not been deemed worth recording or analyzing (8). In 1962, Drs. Becker, Bachman, and Friedman (20), used the variations of direct current in the brain to measure levels of irritability for schizophrenic and normal persons. The preliminary study measured electrical current potentials daily for two months. The results showed a definite 28-day pattern with all four of the subjects following similar patterns. Sleep researchers Drs. Shurley and Pierce (10) discovered by accident a definite 28-day cyclic pattern. While doing research in Antarctica, a physicist kept a record of the exact time when he retired each night. Shurley and Pierce found the physicist went to bed later and later for 28 nights and then reverted to his original time of retiring.

Dr. Hamburger (8), a renowned Danish endocrinologist, conducted a careful 16-year study of the fluctuations of hormones in male urine. Daily records were kept of the levels of a group known as the 17 ketosteriods. The results of an analysis of the daily hormonal fluctuations indicated a rhythm of roughly 30 days in addition to a pronounced circadian or 24-hour rhythm.

Luce (8), in her monograph containing hundreds of studies documenting biological cycles known to man, has cited numerous examples of periodic illnesses in humans, both mental and physical. These were limited to individual case histories because few physicians are cycle conscious, and therefore, have failed to record serial records of their changes or their patients. Another major factor cited by Luce was that data analysis has only recently become sophisticated enough to reveal many of the slow rhythms in man, such as the long periods of seasonal or annual rhythms.

Even such a well known seasonal cycle as the "summer hormone" which has helped to reduce body heat has been difficult to study (8). The "summer hormone" is a thyroid product whose triggering mechanism is still unknown. Other annual rhythms have been a little better documented. Dr. Mayerbach (10) has found annual changes in tissue of laboratory animals kept under standardized conditions of food, temperature, and humidity.

Drs. Haus and Halberg (8) made a startling discovery. Their inbred antiseptically treated mice lived in a controlled environment with standardized lighting to exclude major seasonal cues. Nonetheless, the coricostrone, and adrenal hormone in the blood showed definite annual cycles.

Recently, Halberg (8) found some of man's own annual rhythms. Analyzing statistics from the Minnesota Department of Health, he found rhythms in suicides and suicide attempts and in deaths from arteriosclerosis. He stipulated that these can only apply to the temperature zones and may relate to social custom. He found peaks in accidental deaths in July and August, deaths from arteriosclerosis in January, and suicides in May.

Bohlen (8) studied Eskimos for an answer to the mysterious but well known "arctic madness." He found that there was an annual physiological rhythm in Eskimos living at Wainwright, Alaska. Bohlen and his wife recorded a definite annual rhythm in calcium excretion with the Eskimos excreting eight to 10 times as much calcium in winter as in the summer. In humans, calcium has a profound influence upon the functioning of the nervous system in transmission of nervous messages. It has been postulated that since the Eskimos suffer from an unusual amount of emotional illnesses that the keys to the mysterious "arctic hysteria" may lie buried within the time cycle of man's physiology.

Many researchers and scientists are recommending that biological cycles be considered as a major factor in life processes and be included in the basic science text along with growth, metabolism, and reproduction (2,4,8,9,12). The idea of biological cycles has become an accepted fundamental part of a living organism's system (1,2,3,4,5,6,8,9, 10,12,23,26,28,31,33). Long term rhythms have been shown to exist in man in many various parts of a living organism's system (2,5,8,12,20,21,28,33,37). The idea that biological cycles may hold the keys to many of the secrets of man's physiology has been postulated.

Despite the cultural differences, biological cycles are beginning to be accepted as a scientific fact by both researchers and laymen (3,12). Since Hippocrates' time, man has learned of the biological clock located within his body that controls his sleep patterns (8,21), emotional and psychological changes (8), and hormone excretions (8,26,28) in a 28 day or monthly biological cycle. Researchers (8,11) have also discovered seasonal or annual rhythms in deaths caused by heart disease, suicides, and calcium excretions that influence the transmission of nervous messages (8). Biological cycles have become such a basic part of the living processes that several scientists (1,2,3) have suggested including it in the basic science text.

Biorhythms Research

Discovery

Biological rhythms in man were discovered because of a phenomenon of periodicity reported by Fliess in a medical review (15). Swoboda, Fliess, and Teltscher (15) have been credited with the basic research and discovery of "long term" rhythmic cycles, specifically, the 23-day, 28-day, and 33-day rhythms. They have ascribed these fluctuations to charges and discharges in the cell system.

Swoboda (13), a psychologist, was interested in whether man's feelings and actions could be precalculated. Having a deep interest in the study of dreams and their origins, he noted that melodies and ideas would often repeat in one's mind after periodic intervals. Generally, he found these to be based on a 23-day or a 28-day rhythm. Dr. Swoboda's book The Year of Seven (13) contained the 23- and 28-day mathematical analysis of the rhythmical repetition of births through generations.

> With documentation covering hundreds of family trees, he endeavored to verify that most major events in life, such as birth, the onset of an illness, heart attacks, and deaths fall on periodic "critical days" and involved family relationships (15:18).

At the same time in Berlin, Fliess's research (15) led him to believe that a periodic process must affect both men and women, and these rhythms could be traced throughout life. Believing that both male and female sexual characteristics were inherited by each individual, he postulated everyone had elements of bisexuality in his make up. "He concluded that there was a connection between the rhythms he had observed and evolution, the creation of organisms and life itself." (15:18)

Fliess (15) also studied inherited characteristics in his research of rhythmical repetition in life, especially left-handedness. He attributed this to a greater influence of sensitivity (feminine) rhythm reflecting a higher degree of creative feeling such as is often observed in artists, composers, and writers. He recorded births and deaths in connection with family tree studies and established a mathematical connection in blood relationship going back over many generations. Fliess (15) continued his studies of the regular patterns of life and concluded that the 23-day cycle (masculine) rhythm affected the physical condition of man. Fliess also attributed the 28-day rhythm to the rhythmical changes of the feminine inheritance that influenced the emotions and one's degree of sensitivity.

While doing research at Innsbruck, Germany, Teltscher (15), a teacher and doctor of engineering, discovered a 33-day cycle having to do with mental efficiency. He collected academic records of high school and college students at Innsbruck, after noting that students seemed to fluctuate between intellectual ups and downs. Teltscher did a limited statistical sampling of the school records, and he stated that an exact pattern did exist and that student performance fluctuated in high and low peaks over a definite 33-day cycle (15).

Swoboda, Fliess, and Teltscher (15) individually stated these cycles consistently showed a person's capacities to increase during the first half of the rhythm and to decline during the second half. Critical or "flux" days, days the individual's system (physical, emotional, mental) went through a period of instability switching from regenerative to discharge or vice-versa, occurred at the beginning and middle of each cycle. A critical period occurred when any one, pair, or all of these serpential rhythms crossed the x-axis that represented continuing time. Swoboda and Fliess (15) believed that critical period was the most important time. In the 28-day cycle this was the time a person becomes most irritable. In the 23-day cycle this was the period when such things as on the job accidents were most likely to occurr. Teltscher (15) felt a person above the time continuum would be able to think quickly and efficiently, and a person below the x-axis would not be able to grasp the same ideas as quickly or readily. The biorhythmic theory, as put forth by Fliess, Teltscher, and Swoboda, was limited to self-induced human error and not to error caused by others or due to circumstances.

The researchers Swoboda, Fliess, and Teltscher (14) discovered that three cycles influence the increase and decrease of a person's physical, sensitivity, and intellectual capabilities over a period of days. The three cycles have become known as biorhythms. The length of these cycles were 23 days for the physical cycle, 28 days for the sensitivity cycle, and 33 days for the intellectual cycle. They followed a sine curve or serpential wave pattern the same as other biological cycles, and a person experienced a critical day or state of flux day when the curve crossed the time continuum or x-axis. During this period the chances of a person making a mistake in the physical or emotional domain increased. In all three biological cycles, a person who was above the x-axis on the sine curve would operate at his best, while a person below the x-axis would function poorly and have decreased operating capacities.

Applications of Biorhythms

General

During the 1930's, Hans Schwing earned his Doctorate of Natural Sciences from the Swiss Institute of Technology, Zurich, Switzerland, with a dissertation on the relationship of "critical" days to incidents of accidental injury and death. He found that six out of 10 people were in critical days in either the physical or emotional cycles or both when accidents occurred. Studying accidental deaths, he found the percentage was even higher, 65 percent. These facts became even more significant when one realized that critical days occurred only twice in each complete cycle, or less than 16 percent of the time (15).

In 1954, J. Bochow and J. Sennewald (15) of The University of Berlin investigated accidents of workers using agricultural machinery. They used the three biorhythmic cycles (23-, 28- and 33-day cycles) and studied 497 accidents. The accident results showed that 24.75 percent fell on triple critical days, 46.5 percent occurred on double critical days, 26.5 percent on single critical days, and only 2.2 percent on mixed rhythm days.

A report by Tope (15), chief engineer for Hanover, Germany, was released in September, 1956. He had investigated accidents of city shop workers, street cleaners, and truck drivers using biorhythm calculations. After analyzing the accidents, Tope found that 83 percent were related to biorhythmic critical days. Similarly, Anderson, president of a safety consultant firm in New Jersey, completed a two-year study that looked at 300 accidents in four industrial plants. In a complete analysis of all accidents occurring in four plants, Anderson found 70 percent occurred on critical days. The titanium division of N. L. Industries instituted biorhythms as an accident prevention device. The project began July 1965, with two of their three shops using biorhythms. The third shop acted as a control group. The first shop reduced injuries by 18 percent in 1965 and 42 percent in 1966. The second shop had a four percent decrease each year. The control group showed a 28 percent increase in accidents (15).

Drs. Bodmer and Wernli (16) introduced biorhythms into the Kurhaus Villa Montana (medical clinic) Locano, Switzerland. In more than 10,000 cases in which patients' biorhythms were considered in treatment, no accidents occurred. In cases of emergency where biorhythms could not be considered, complications arose in 30 to 60 percent of the cases.

Two firms have instituted studies of biorhythms and accident rates involving their employees. The Omi Railroad of Japan, which runs 700 taxis and buses and a primary railroad in two of Japan's metropolitan areas, has reported a decrease by one-third in their accident rate in a two-year period, despite increased traffic during that period. The Washington Airport also instituted a biorhythms program in 1973. In the following 12 months, they reduced accidents by more than 50 percent. Major airlines including United, Allegheny, TWA, Pan American, and Continental, as well as Bell Telephone, have been looking into the idea of biorhythms (33).

Brady (21) studied the relationship of biorhythms and aircraft accidents within the Tactical Air Command between the years of 1969 and 1971. Of the 59 accidents analyzed, 13 occurred when at least one of the pilots involved had two or three of the rhythms in the low phase. In another study of airplane accidents, Woodham (15) used accidents involving private pilots. In this case, 80 percent of the accidents occurred when the pilot had a critical day in one of his rhythms. Woodham concluded that there appeared to be a definite relationship between a pilot's error on a particular date and his physiological cycles as determined by biorhythmic theory. In an additional study, cited by Zito (36), and involving 144 airline mechanics, 91 had accidents in their "down" periods and 36 while in the "up" stages of their biorhythms.

In addition to being used in hospitals, industry, and by airplanes, biorhythms have been shown to have an effect upon the educational process. Schnepper (37), a professor of economics at the State University College at

Geneseo, New York, used 150 students from four advanced accounting classes in a study of the effects of biorhythms upon test scores. Each professor of economics predicted final grades within plus or minus five points for each student. Of the 14 students with triple highs, 10 exceeded predictions by 10 points and six by 15 points. The nine students with triple lows were below teacher expectations by 10 points. Sixty-eight of the 92 students with two curves above the x-axis out performed the expectations of their instructors. Of the 35 students with two curves below the time continuum, 27 were below expectations. Therefore, Schnepper (37) concluded that "biorhythms analysis was able to predict performance with amazing accuracy" (37:5).

Athletic Performance

Conducting a study with male swimmers, Herring (27) classified them into four groups with each person keeping a daily log. In three groups the coach and/or the swimmer was aware of his biorhythms before practice. The fourth group did not calculate their biorhythms and compare them with their daily logs until the end of the season. Herring (27) found no significant difference in the results of the four groups and ruled out the possibility of power of suggestion. He did find that the physical cycle had a greater affect on the swimmers tested although some were more strongly affected by the emotional cycle. He stated that "in most cases biorhythms followed more true for practice periods than for meets especially of those training the hardest" (27:75). His results showed practice times followed biorhythms with 90 percent accuracy.

Wallerstein and Roberts (35) developed the theory that biorhythms affect individuals in their athletic performances; thus, a composite of the individual biorhythms of a team would predict team performance for that day. They did so for the Los Angeles Rams individual games during the 1972 season, the 1972 Super Bowl game, and the USC-UCLA football game on November 18, 1972. Their lone mistake involved the Super Bowl game in which they picked the Washington Redskins over the Miami Dolphins in a come-from-behind victory.

Substantial empirical data have been presented from studies (15,16,22,33,35,37) completed in many areas of human performance. All of the studies (13,15,21,32,35) reported in industry have been of serious accidents or deaths in which the authors have had reliable information due to worker's compensation accident investigation reports, civil or military aeronautics investigative reports, or hospital records. In each study, the writer has found a very significant relationship between accidents and a person's biorhythms. In recent years the findings have focused the interest of many large corporations on biorhythms as an accident prevention device. Academicians and the sports world alike have just begun to develop an interest in the affect of biorhythms on student and athletic performances.

Summary

Biological cycles are being accepted by more laymen and scientists each year as a basic process fundamental to man's nature. Although records of the existence of cycles in humanity have existed for many centuries, western scientists have only begun to scratch the surface for information. Experimental studies have documented the existence of near monthly, seasonal, and annual biological cycles which influence our emotions, intellectual capacities, physical, and mental illnesses, and body hormone levels.

Three of these biological cycles that have received the layman's attention through numerous news publications (19,20,24,27,30,31,32,33,34,35,36) and two books (15,16) are called biorhythms. These cycles were discovered individually around the turn of the century by two medical doctors and an engineering professor in Germany. They (15, 16) found that each cycle influenced a person's capabilities in the physical, emotional, and intellectual domains. During the time when the physical or emotional cycle had a critical day, a person was particularly apt to make mistakes. Generally if a person was above the time continuum or x-axis in any one of the cycles, he would have increased operating capacities in that domain. Similarly, should he have been below the x-axis, his capabilities in that area would be decreased.

Businesses, hospitals, industrial plants, and safety consultant firms have studied the relationship between accidents or deaths and biorhythms. Each study has shown a very high relationship between a person's critical or down phase of biorhythms and accidents and deaths. These results have led major international corporations in recent years to consider the use of biorhythms as an accident prevention device. The effect of biorhythms on a person's ability to grasp new ideas or to perform well has just begun to draw our interest. The influence of biorhythms on athletic performance as shown through individual case histories and studies have led observers to believe that a relationship does exist between the two.

Chapter 3

METHODS AND PROCEDURES

The purpose of this chapter was to present the methods and procedures used in this study. This chapter has been divided into the following subtopics: (1) selection of subjects, (2) methods of data collection, (3) treatment of data, and (4) summary.

Selection of Subjects

All subjects who participated in this investigation were from the Ithaca YMCA winter competitive swim team. The Ithaca YMCA age-group competitive swim team program was divided into three levels, namely, A, B, and Novice. The 80 subjects ranged between 6 and 17 years of age. The sample included 34 males and 46 females.

Methods of Data Collection

During each of the two winter YMCA seasons, ten dual meets were swum; five were "home" meets, and five were "away" meets. The Ithaca YMCA participated in three cham- poinship meets at the conclusion of each season. The first was a district meet; the second and third were the

Boys and Girls State meets held separately at different locations within the State of New York. Swimmers were limited to swimming in three events, including relays, during the 1973 and 1974 dual meet seasons and the championship meets of 1973. At the 1974 championship meets, swimmers were allowed to swim three events at the district meet and five events at the state meet, including relays.

The official elapsed time for each swimmer in each event was recorded by electronic timing systems or by an individual timer or timers assigned to each lane. Each swimmer's name and official time were transcribed to an official result sheet, and the finishing order was determined. Upon completion of the meet, each coach received a carbon copy of the official results. The swimmer's individual event times were taken from the official results and entered on composite seasonal data forms by date, stroke, and distance (Appendix A). Relay splits were taken by the coaches, recorded, and later transferred to the data sheets.

Following completion of each season, subjects with more than five recorded times for an event had a standard X/Y graph with a regression line plotted by the Univac Series 70/35E computer at Ithaca College (see Appendix B). Plotting of graphs was done in relation to the performance date (x-axis) and the official time (y-axis). A regression line was then computed from these series of points by means of the least-square curve fit. Those times located above the regression line were considered poor performances. Those times located below the regression line were considered good performances.

Since a person's birth has been established as the point of origin for biorhythms, a birthdate was needed to calculate a person's position in the three cycles, the total number of days since birth must be determined. The total amount of days calculated is then divided by the length of the cycle. For example, a person wanting to know his biorhythms for October 1, 1972, having been born on August 10, 1940, would have a total of 11,741 days. To determine the position of the 23-day cycle, one would divide 11,741 by 23 and find the person had completed 510 cycles with a remainder of 11 days. This would place him in the eleventh day of his cycle (15).

To facilitate these computations, calculation tables were originated by Alfred Judt during the late 1920's (15). These tables were designed with a relationship between day of birth, the year of birth, and the day of event. Each table provided the researcher with one value for each cycle; values for each cycle were added separately. The first table provided a value for his birth year. The second table provided a value for his birth date. These basic values never change. The third table provides a value for the first day of the month and year in question. The basic values from table one and two are added to the value in table three. The total value was then divided by the number of days in the cycle. This final value provided a person with the number of cycles completed and a remainder. The remainder told the position of that person in that particular cycle at the first of that particular month.

Because of the number of calculations needed to be determined, a computer program to calculate biorhythms was constructed by an Ithaca College computer consultant. Information, directions, and the necessary data were drawn from Thommen (15) and Wernli (16). The program's reliability was checked by testing 25 birthdates and event dates. The three cycles' positions for each of the 25 event dates were computed by hand and by the biorhythms computer program. The program was determined to be reliable when the correlation between hand calculations and the computer program was 1.00.

The data card information for the biorhythms computer program included the following: (1) subject number; (2) birthdate of the subject (month, day, and year); (3) date of event (month, day, and year); (4) stroke and distance of event swum; (5) swimmer's finishing time; (6) and the evaluation of the swimmer's performance. Upon execution of the program, the following information was recorded: (1) the subject's number; (2) each cycle by name and the position of the sine curve in integer form with an accompanying positive (+), negative (-), or critical (X) sign; (3) the day of the event; (4) the swimmer's time; (5) the distance swum; and (6) the evaluation, positive (+), or negative (-), of the performance.

Treatment of Data

From each graph, two performances, one good and one poor, were selected. Those points selected were located the greatest distance from the regression line. In the case of two different points being located the same distance from the regression line, the closest to the end of the season was selected. The Cochran Q test, a chi-square test for a number of independent samples, was selected to treat the data. The Cochran Q test is an overall test which was to determine whether (K) samples exhibit significantly different frequencies of "successes," of positive and negative days. The data were arranged in a two-way table of N rows and K columns to test a null hypothesis. The table included total number of successes (G_1) for each, total number of successes for each subject (L), total number of successes squared (L^2), and the Q value.

The chi-square test of independence in contingency tables was used to determine if there was any relationship between swimming performances and biorhythmic cycles. The hypothesis to be tested was the null hypothesis; namely, that swimming performances and biorhythms were unrelated or independent. To calculate chi square, the "independence" value or frequency expected was found and was obtained by multiplying the row (positive biorhythms) total by column total good performance evaluations from a 2 X 2 contingency table and dividing by the frequency expected. When these expected values were computed, the difference between the observed and expected values from each cell was obtained, each difference was squared, and divided in each instance by the independence value. The sum of the values gave a chi-square value.

The .05 level of significance was used.

Summary

Data were collected from 80 subjects who participated in the Ithaca YMCA winter competitive swim program during 1973 and 1974. From the official meet results, the swimmer's times were transcribed to composite seasonal data forms for each subject by date, stroke, and distance. Upon completion of each season, subjects with more than five recorded times for an event were plotted on a X/Y graph, and a regression line was computed. Two times, one on each side of the regression line were selected as good and poor performances. Biorhythms for each good and poor performances were then calculated. The Cochran Q test was then used to analyze the data to determine if the positive or the negative performances exhibited significantly different frequencies of prediction. The chi-square test for independence was used to determine if there was a significant relationship between positions of biorhythms and swimming performances.

The .05 level of significance was used.

Chapter 4

RESULTS

Results of the influence of biorhythms upon swimming performance are presented in this chapter. The subjects' performances while participating in the Ithaca YMCA age-group winter competitive swim program were obtained, and the biorhythms calculated to determine if there was any relationship with swimming performances. This chapter has been divided into the following subtopics: (1) Cochran Q test, (2) chi square for individual cycles, (3) chi square for multiple cycles, and (4) summary.

Cochran Q Test

The Cochran Q test, a chi-square test for a number of independent samples, was used to determine if there was any significant difference in frequency of occurrences of positive and negative days. Each subject's two performance evaluations were compared with their position in each biorhythmic cycle. A "1" was assigned to each evaluation which matched the position of the subject in a cycle. A "0" was assigned to each evaluation which did not match the position of the subject in a cycle (example: positive evaluation, a positive cycle position received a "1"; a positive evaluation and a negative cycle position received a "0").

The data were arranged in a two-way table of N rows and K columns to test the null hypothesis. Total number of successes, for each evaluation, total number of successes for each subject (L), total number of successes squared (L^2), and Q value for individual cycles are presented in Table 1.

Q Values of 0.62, 2.11, and 3.32 were found for the physical, emotional, and intellectual biorhythms. At the .05 level of confidence, with one degree of freedom, a Q ratio of 3.84 was needed to be significant. From this result the conclusion was drawn that the null hypothesis was true and that no difference existed in frequency of occurrence in any of the three cycles, physical, emotional, or intellectual.

Chi-Square for Individual Cycles

The chi-square test for independence was used to determine if a relationship existed between biorhythmic positions and swimming performances. The chi-square test summed the value of individual cells where the squared difference between observed and expected frequencies was divided by the expected frequency. The individual cycles, the observed frequencies, expected frequencies, and chi-square values are found in Table 2.

Table 1

The Frequency of Occurrences of Positive and Negative Days in the Individual Cycles and the Q Values for Each Cycle

	Positive Cycle Evaluation	Negative Cycle Evaluation	Total Successes For Both Categories (L)	L^2	Q Value
Physical Cycle	71	91	162	232	0.6173
Emotional Cycle	80	94	174	255	2.0175
Intellectual Cycle	61	78	139	191	3.3218

Table 2

The Observed Frequencies (Fo), Expected Frequencies (Fe), and Chi-Square (X^2) Value for Each Individual Cycle in a Test for Independence (N= 165)

Biorhythm Cycle	Evaluation	Cycle Position	Fe	Fo	F_{total}	Fo - Fe	X^2
Physical	+	+	71.5	70	143	1.5	0.08
		-	71.5	73		1.5	
	-	+	93.5	95	187	1.5	
		-	93.5	92		1.5	
Emotional	+	+	75.5	80	151	4.5	0.99
		-	75.5	71		4.5	
	-	+	89.5	85	179	4.5	
		-	89.5	94		4.5	
Intellectual	+	+	74.5	62	149	12.5	7.65*
		-	74.5	87		12.5	
	-	+	74.5	103	181	12.5	
		-	74.5	78		12.5	

*X^2, $p < .05 = 3.84$

The chi-square values for the physical, emotional, and intellectual cycles were 0.08, 0.99, and 7.65. At the .05 level of confidence with one degree of freedom a chi-square value of 3.84 was needed to be significant. The large value (7.65) obtained in the intellectual cycle was due to the existence of a large number of occurrences in the off-diagonal (good performances while in the negative cycle and poor performances while in the positive cycle). Because the chi-square test was a one-tailed test (expecting large frequencies to occur in the diagonal area), the results of the chi-square test performed on the intellectual cycle were found to be non-significant. The frequencies of occurrence of critical days listed in Table 3 show no relationship between critical days and swimming performances in the individual cycles. From the results of statistical analysis, the conclusion was drawn that no relationship existed between any one of the individual biorhythmic cycles and swimming performances.

Chi Square for Multiple Cycles

The double cycles (physical-emotional), emotional-intellectual, physical-intellectual) observed frequencies, expected frequencies, and chi-square values are given in Table 4. The frequencies of occurrence of highs, lows, and critical days are listed in Table 5. The difference between expected frequencies and observed frequencies in the paired

Table 3

Number of Positive, Negative, and Critical Days Occurring in Each Individual Cycle

	Positive Evaluation			Negative Evaluation		
	Number of Positive Days	Number of Negative Days	Number of Critical Days	Number of Positive Days	Number of Negative Days	Number of Critical Days
Physical	70	74	21	73	74	18
Emotional	80	72	13	71	83	11
Intellectual	62	76	27	87	72	6

Table 4

The Observed Frequencies (Fo), Expected Frequencies (Fe), and Chi Square (X^2) Value for Each Dual Cycle In a Test for Independence (N = 138, 136, 122)

Biorhythm Cycle	Evaluation	Cycle Position	Fe	Fo	F_{total}	Fo - Fe	X^2
Physical-Emotional	+	+	34.4	34	138	0.4	0.55
		-	34.4	38		3.6	
	-	+	34.4	32	138	2.4	
		-	34.4	34		0.4	
Emotional-Intellectual	+	+	30.6	30	136	0.6	1.54
		-	30.6	36		5.4	
	-	+	37.6	33	136	4.6	
		-	37.6	37		0.6	
Physical-Intellectual	+	+	30.5	26	122	4.5	2.66
		-	30.5	35		4.5	
	-	+	30.5	35	122	4.5	
		-	30.5	26		4.5	

Table 5

Number of Positive, Negative, and Critical Days Occurring in Each Dual Cycle

	Positive Evaluation			Negative Evaluation		
	Number of Positive Days	Number of Negative Days	Number of Critical Days	Number of Positive Days	Number of Negative Days	Number of Critical Days
Physical - Emotional	34	35	3	32	34	0
Emotional - Intellectual	30	31	2	36	34	3
Physical - Intellectual	26	33	2	35	26	0

cycles was small as indicated by the chi-square values of 0.55, 1.54, and 2.66 that were found for the paired cycles, physical-emotional, emotional-intellectual, and physical-intellectual. At the .05 level of confidence with one degree of freedom, a chi-square of 3.84 was required to be significant. The frequencies of occurrence of critical days listed in Table 5, show no relationship between critical days and swimming performances in the paired cycles. From these results, a conclusion was drawn that no relationship existed between any two cycles and swimming performances.

Observed frequencies, expected frequencies, and chi-square value for the triple cycle (physical-emotional-intellectual) are presented in Table 6. Since the chi-square value found for the triple cycle was 1.19 which was non-significant, the conclusion was drawn that no relationship existed between the triple occurrences of high or low in the biorhythmic cycles and swimming performances. It should be stipulated that no conclusions can be drawn for the triple cycles concerning critical days as there were no occurrences in particular frequency in either the positive or negative evaluations, as shown in Table 7.

Summary

Results of the influence of biorhythms upon swimming performances were presented in this chapter. The subjects' performances while participating in the Ithaca YMCA

Table 6

The Observed Frequencies (Fo), Expected Frequencies (Fe), and Chi-Square (X^2) Value for the Triple Cycle in a Test for Independence (N = 52)

Biorhythm Cycle	Evaluation	Cycle Position	Fe	Fo	F_{total}	$F_o - F_e$	X^2
		+	13.5	12		1.5	
	+				52		
Physical-Emotional-Intellectual		-	13.5	13		0.5	1.19
		+	14.5	16		1.5	
	-				52		
		-	14.5	11		3.5	

Table 7

Number of Positive, Negative, and Critical Days Occurring in the Triple Cycle

	Positive Evalution			Negative Evaluation		
	Number of Positive Days	Number of Negative Days	Number of Critical Days	Number of Positive Days	Number of Negative Days	Number of Critical Days
Physical - Emotional - Intellectual	12	16	0	13	11	0

age-group winter competitive swim program were obtained and the biorhythms calculated to determine if there was any relationship with swimming performances.

The Cochran Q test, a chi-square test for a number of independent samples was used to determine if there were any significant difference in frequency of occurrences between 165 positive and 165 negative days. Q values of 0.62, 2.11, and 3.32 were found for the physical, emotional, and intellectual biorhythms respectively.

The chi-square test for independence was used to determine if a relationship existed between biorhythmic positions and swimming performances. For the individual cycles, chi-square values of 0.08, 0.99, and 7.65 were found for the physical, emotional, and intellectual cycles. The occurrence of a large number of performances in the off-diagonal of the chi-square test caused a significant difference to appear, contradicting the research hypothesis. Because chi-square is a one-tailed test, the results found were determined to be non-significant.

Chi-square values of 0.55, 1.54, and 2.66 were found for the paired cycles, physical-emotional, emotional-intellectual, and physical-intellectual. For the triple cycle, physical-emotional-intellectual, a chi-square value of 1.19 was found. From the results of this study, the conclusion was drawn that no relationship existed between individual cycles, and combination of paired cycles, or the triple cycle in biorhythms and swimming performances.

Chapter 5

DISCUSSION OF RESULTS

Discussion of the results from this study of the effect of biorhythms on swimming performances are presented in this chapter. One good and one poor performance from each subject was used to determine if biorhythms had a significant influence upon swimming performances.

The elapsed times for each event were collected from swimming scheduled during the Ithaca YMCA winter competitive swim program. From the times evaluated, one good and one poor performance were selected to be compared with individual's biorhythms for those event dates. The Cochran Q test was used to determine if there was any significant differences in frequencies of prediction between the good and poor evaluations. Q values of 0.62, 2.1, and 3.32 were found for the physical, emotional, and intellectual cycles respectively. These values indicated that there was no significant difference in frequencies of prediction between the good and poor evaluations.

The chi-square test was used to determine if any relationship existed between swimming performances and any individual biorhythm or combination of biorhythm cycles. Chi-square values found were 0.08, 0.99, and 7.65 for individual cycles as predictors. For the three possible combinations of paired cycles namely physical-emotional, emotional-intellectual, physical-intellectual, chi-square values were 0.55, 1.54, and 2.66 respectively. A chi-square value for the triple cycle combination was determined to be 1.19. No individual or combination of cycles were found to have a significant chi-square value.

Within the restrictions of this study some support is added to Herring's belief (27) that in most cases biorhythms hold less true for meets than practices. Since no relationship could be found between highs, lows, or critical days and swimming meet performances, there can be no agreement with the rest of available literature. However, this could be due to the application of a crude statistical instrument to a very sensitive mechanism (biorhythms). There are several valid reasons to support the idea that there is not currently available to us a sensitive enough instrument to test biorhythms reliably. The first is a variation between and within subjects in which the sine curve may be deeper for one cycle than another cycle (example: the physical cycle may affect some people more than the emotional or intellectual or vice versa). This would mean that a person more affected by the physical cycle who had a good or average performance on a critcal day in the emotional cycle would mislead the statistical instrument.

Continuing with the variation between subjects there is the possibility that the height of the sine curve is the same or different for each individual cycle. If the sine curve was relatively shallow, the subject may need a double or even triple critical day before his performance is affected. On the other hand if the sine curve is relatively deep, it may only take a single critical day to affect a subject's performance appreciably.

Two other reasons affecting critical days could be the intensity and duration of the task. Many studies (15, 17,22,33,36) available today deal with persons in day to day jobs who fall into a pattern of low intensity and high duration. Even within the swimming performances the intensity factor can vary depending upon whether it is an easy or hard dual meet for the team or individual or an easy or tough championship for the individual or team. Also, the duration factor plays a large part since the events generally range between 14 seconds and eight minutes in length and can be five minutes apart or two or three hours apart.

Age and sex may also play a significant part in the biological cycles of the subjects. The literature available (13,15,16,17,21) suggest a majority of the studies concerning biorhythms concentrate on those persons holding jobs. These persons tend to be 18 years or older. Both factors could influence the steepness of the sine curve of any one or all of the cycles.

Summary

Discussion of the results from this study of the effect of biorhythms on swimming performances were presented in this chapter. One good and one poor performance from each subject was used to determine if biorhythms had a significant influence upon swimming performances. Q values showed that there was no significant difference in frequencies of prediction between the good and poor evaluation. Chi-square values showed that no significant relationship existed between swimming performances and any individual cycles, combinations of paired cycles, or the three cycles together. Within the limitations of this study it was shown that there was no significant relationship between critical days and a person's good or poor swimming performances. Factors such as the use of a crude statistical instrument on a delicate mechanism, could have been caused by variations between and within the subjects' sine curves of each cycle. Other factors which may have influenced the study include the intensity and duration of the task and the age and sex of the subjects.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine what, if any, relationship existed between swimming performances and biorhythms. Thirty-four males and 47 females from the Ithaca YMCA winter competitive swim teams of 1973 and 1974 served as subjects for this study. Each subject that had more than five times for an event had an X/Y graph plotted and a regression line computed using the least-square curve fit. Times located below the regression line were considered good performances and time located above the regression line were considered poor performances. Two lines, one on each side, located the greatest distance from the regression line were selected as a good and a poor performance. Biorhythms for each performance were calculated by the biorhythms computer program.

The frequency of successes for each individual cycle were treated by the Cochran Q test and produced no significant difference. This indicated that the frequencies did not differ between the performance evaluations in either of the three cycles. The chi-square test for independent was used to determine what, if any, relationship existed between swimming performances and individual cycles, all possible paired combinations, or all three cycles together. No significant relationship was found to exist between swimming performances and individual cycles, all paired combination of cycles, or the three cycles together.

Conclusions

Within the limitations of the study the following conclusions are warranted:

1. Neither positive nor negative cycle positions of the physical, emotional, and intellectual biorhythmic cycles were related to swimming performance.

2. No combination of physical, emotional and intellectual biorhythmic cycles were related to swimming performance.

3. Biorhythmic "critical days" did not influence swimming performance.

Recommendations

From the results of this study the following investigations are recommended:

1. A study to determine if any relationship exists between biorhythms and swimming workouts.

2. A study to determine if there is any relationship between world class swimming performances and biorhythms.

3. A study to determine if there is any relationship between biorhythms and games or workouts for professional players (baseball, auto racing, football, basketball, hockey, volleyball).

4. A study to determine if one of the individual cycles has more influence than the other two cycles upon individuals.

5. A study to determine if a relationship exists between biorhythms and amateur sports which need a great deal more hand-eye and hand-leg coordination such as figure skating, gymnastics, or golf.

6. A study to determine if there is any relationship between biorhythms and a person's reaction time.

7. A study to determine if there is any relationship between biorhythms and a person's general attitude over a period of time.

8. A study to determine if age is a factor in the effect biorhythms have upon a person.

Appendix A

Biorhythms Printout

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FORTRAN IV PROGRAM T7OR25 (LINK-EDITED AS MAINPROG) STARTED --- 04/18/75

FOR SUBJECT  1   CYCLE  23   THE DAY IN THE CYCLE IS   8+   DAY EVENT  2/23/74   TIME  1.19.80   EVENT 100FR -
FOR SUBJECT  1   CYCLE  28   THE DAY IN THE CYCLE IS  17-   DAY EVENT  2/23/74   TIME  1.19.80   EVENT 100FR -
FOR SUBJECT  1   CYCLE  33   THE DAY IN THE CYCLE IS   9+   DAY EVENT  2/23/74   TIME  1.19.80   EVENT 100FR -

FOR SUBJECT  1   CYCLE  23   THE DAY IN THE CYCLE IS  22-   DAY EVENT  3/ 9/74   TIME  1.16.60   EVENT 100FR +
FOR SUBJECT  1   CYCLE  28   THE DAY IN THE CYCLE IS   3+   DAY EVENT  3/ 9/74   TIME  1.16.60   EVENT 100FR +
FOR SUBJECT  1   CYCLE  33   THE DAY IN THE CYCLE IS  23-   DAY EVENT  3/ 9/74   TIME  1.16.60   EVENT 100FR +

FOR SUBJECT  1   CYCLE  23   THE DAY IN THE CYCLE IS  20-   DAY EVENT  3/30/74   TIME  0.35.20   EVENT  50FR -
FOR SUBJECT  1   CYCLE  28   THE DAY IN THE CYCLE IS  24-   DAY EVENT  3/30/74   TIME  0.35.20   EVENT  50FR -
FOR SUBJECT  1   CYCLE  33   THE DAY IN THE CYCLE IS  11+   DAY EVENT  3/30/74   TIME  0.35.20   EVENT  50FR -

FOR SUBJECT  1   CYCLE  23   THE DAY IN THE CYCLE IS   8+   DAY EVENT  2/23/74   TIME  0.33.10   EVENT  50FR +
FOR SUBJECT  1   CYCLE  28   THE DAY IN THE CYCLE IS  17-   DAY EVENT  2/23/74   TIME  0.33.10   EVENT  50FR +
FOR SUBJECT  1   CYCLE  33   THE DAY IN THE CYCLE IS   9+   DAY EVENT  2/23/74   TIME  0.33.10   EVENT  50FR +

FOR SUBJECT  2   CYCLE  23   THE DAY IN THE CYCLE IS  18-   DAY EVENT  2/23/74   TIME  1.11. 9   EVENT 100FR -
FOR SUBJECT  2   CYCLE  28   THE DAY IN THE CYCLE IS   7+   DAY EVENT  2/23/74   TIME  1.11. 9   EVENT 100FR -
FOR SUBJECT  2   CYCLE  33   THE DAY IN THE CYCLE IS  29-   DAY EVENT  2/23/74   TIME  1.11. 9   EVENT 100FR -

FOR SUBJECT  2   CYCLE  23   THE DAY IN THE CYCLE IS  11+   DAY EVENT  2/16/74   TIME  1. 8.50   EVENT 100FR +
FOR SUBJECT  2   CYCLE  28   THE DAY IN THE CYCLE IS   0-   DAY EVENT  2/16/74   TIME  1. 8.50   EVENT 100FR +
FOR SUBJECT  2   CYCLE  33   THE DAY IN THE CYCLE IS  22-   DAY EVENT  2/16/74   TIME  1. 8.50   EVENT 100FR +

FOR SUBJECT  2   CYCLE  23   THE DAY IN THE CYCLE IS  18-   DAY EVENT  2/23/74   TIME  0.31.50   EVENT  50FR -
FOR SUBJECT  2   CYCLE  28   THE DAY IN THE CYCLE IS   7+   DAY EVENT  2/23/74   TIME  0.31.50   EVENT  50FR -
FOR SUBJECT  2   CYCLE  33   THE DAY IN THE CYCLE IS  29-   DAY EVENT  2/23/74   TIME  0.31.50   EVENT  50FR -

FOR SUBJECT  2   CYCLE  23   THE DAY IN THE CYCLE IS  11+   DAY EVENT  2/16/74   TIME  0.29.40   EVENT  50FR +
FOR SUBJECT  2   CYCLE  28   THE DAY IN THE CYCLE IS   0-   DAY EVENT  2/16/74   TIME  0.29.40   EVENT  50FR +
FOR SUBJECT  2   CYCLE  33   THE DAY IN THE CYCLE IS  22-   DAY EVENT  2/16/74   TIME  0.29.40   EVENT  50FR +
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