AN ABSTRACT OF THE THESIS OF

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Title: A Comparison of the Moving Start and Sprinter's Start When Breaking From a Base in Women's Fast-Pitch Softball

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The purpose of this study was to determine which starting technique, the moving start or the sprinter's start, was most efficient in getting a runner off one base and on the way to the next. Forty - eight subjects were randomly assigned into treatment groups. The three treatment groups were C (control), A (moving start technique), B (sprinter's start technique). All three groups were pretested on how quickly they could run a distance of thirty feet following a pitcher's release of a softball. Subjects were allowed to use the starting technique of their choice. Groups A and B participated in a two-week treatment phase in which group A subjects were taught the moving start and group B the sprinter's start. A posttest was then given with subjects in groups A and B using the starting technique learned. Group C again used the starting technique of their choice.

The differences in each subject's mean pre- and posttest scores were calculated. A one way analysis of variance (ANOVA) was then preformed to determine the percentage of variance among the groups which could be exclusively attributed to the treatment effect at the .05 level of significance.

Although differences in the two groups were found to exist at the .14 level, this did not meet the earlier established level of .05 needed for statistical significance. However, based on the consistency of the pattern for differences found between groups, the .14 level which was obtained was considered to have meaning on a substantive level.

A COMPARISON OF THE MOVING START AND SPRINTER'S START WHEN BREAKING FROM A BASE IN WOMEN'S FAST-PITCH SOFTBALL

A Thesis
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by
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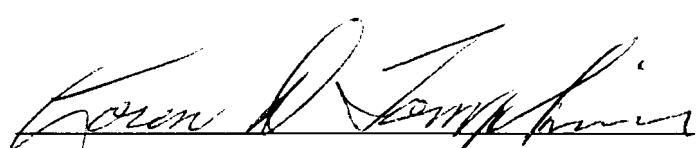

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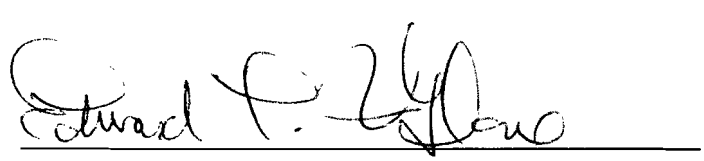

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INTRODUCTION

Baseball has long been thought of as America's game. Each summer thousands of people gather at the ballparks to support their favorite team. It is a game Americans have grown to love. Possibly because of this love, another popular game has emerged in recent decades. That game is softball. Originally invented by George W. Hancock in 1887, the game acquired its present name, softball, from Walter K. Hakanson in 1921 (Humiston & Michel, 1965).

Softball has grown worldwide into both a recreational and highly competitive sport involving people of all ages and skill levels. In its early years, only fast-pitch softball was played; however, in the early 1950's, slow pitch softball emerged (Jones & Murray, 1978). The popularity of slow pitch softball has far exceeded the growth of fast-pitch. A contributing factor for this popularity is the action it provides participants at all age levels. It has been estimated that more than 26 million participants per year play slow pitch softball in the United States (Backus, 1979).

There are many variations between the slow and fast-pitch games of softball. The major difference between slow and fast-pitch is the speed in which the ball is pitched. Slow pitch softball requires a pitcher to arc the ball from six to twelve feet. The opposite of this is true in fast-pitch softball where a ball will approach the plate usually in one

plane and at a much higher speed. The ball can travel between 40-60 miles per hour as it approaches a batter in fast-pitch softball.

A second difference between the two games is the pitching distance to homeplate. In slow pitch, the pitching rubber is 46 feet from homeplate for both men's and women's adult levels of competition. Amateur Softball Association (ASA) rules for women's fast-pitch puts the pitching rubber at 40 feet from homeplate while men pitch from 45 feet. Women's fast-pitch at the collegiate level moves the rubber back three feet to 43 feet.

Another significant difference between slow and fast-pitch is that stealing is allowed in fast-pitch. By allowing stealing in fast-pitch, a runner looks for the quickest way to get off the base and on her way to the next base. A fraction of a second delay in leaving the base could mean the difference between being out or safe at the next base. Runners must be cautious not to leave the base too early for fear of being called out by an umpire.

Stealing in softball is a significant offensive strategy used by teams, yet no one style has been determined as the best stealing technique. It is generally believed there are four different styles of stealing used in softball (Israel & Brown, 1981). The first style is referred to by several names such as a sprinter's start, stationary start, forward stride, or track stance (Israel & Brown, 1981; Drysdale & Harris, 1982; Johnson, 1984; Meyer,1984). A runner stands on base with her

body facing the next base. Her trailing foot is on the base and her lead foot is a comfortable distance toward the next base (Meyer, 1984). At the point the ball is released from the pitcher's hand, the runner pushes off the base with her trailing foot and strides toward the next base.

The second style is very similar, but it involves the runner in motion at the time the ball is released. This technique of starting is called the rocker style, rolling start, moving start, or momentum start (Meyer, 1984; Drysdale, 1982; Meyer, 1982; Israel & Brown, 1981). To execute the moving start, the runner stands in a forward-stride position with her lead foot on the edge of the base closest to the next base (Drysdale & Harris, 1982). The trail foot is about a half step behind the base (Ryan, 1981). As the pitcher starts her delivery, the runner pushes off with her trail foot towards the next base. By the time the pitcher releases the ball, the runner will have landed on her trail foot with her body in motion yet her other foot is still in contact with the base (Acampora, 1986).

A third style is the cross-over step start (Israel, 1980). A player stands facing the pitcher's mound on the advancing side of the base with the outside portion of her left foot in contact with the base. As the ball is released, the runner rotates on the balls of her feet and steps across the right foot with the left. This puts her body in a position facing the next base (Israel & Brown, 1981).

The fourth method is the jab-step which is similar to the cross-over start. A runner takes the same starting position as the cross-over method. Instead of taking the first step with her left foot, she steps toward the next base with the right foot as she rotates on the ball of her left foot. As she continues to run toward the next base, the left foot crosses over the right putting her body in a position facing the next base (Israel & Brown, 1981).

Often the technique used is simply based upon personal preference. In recent years, more players are using the moving start because they believe being in motion at the time of push from the base will get them to the next base faster. "Whether or not it is the best technique for all players... still remains to be seen." (Drysdale & Harris, 1982, p. 202).

Israel and Brown (1981), studied all four of the styles and found the moving start to be the fastest. This study was significant in that the four methods were studied under slow pitch softball conditions. In slow pitch, a runner must wait until the batter contacts the ball before leaving the base. Fast-pitch rules allow a runner to leave the base after the pitcher releases the ball.

Few studies exist that are exclusive to baserunning starting techniques thereby limiting the amount of evidence available to support the superiority of any particular technique. Hundreds of studies have been done on baseball; however, softball is a game which has not had the popularity of baseball until recent years. As softball continues to attract more participants,

studies that contribute to efficient movement and offensive strategy should increase the accuracy of measurement needed to improve the game.

Purpose of the Study

The purpose of this study was to determine which starting technique, the moving start or the sprinter's start, was most efficient. The other two techniques, the cross-over step and the jab-step, although of some use in softball, are most often used in baseball baserunning and therefore were not investigated in this study. Previous research done in this area indicated that conclusions have not yet been reached as to which method is best. It was the purpose of this study to determine which of the two methods, the sprinter's start or the moving start, was most efficient.

Statement of the Problem

This study was designed to investigate two starting techniques used most often in fast-pitch softball, the moving start and the sprinter's start. There is disagreement in the literature regarding which type of starting technique should be used. Scarcity of research on baserunning also makes it difficult to address the problem. The popularity and similarities of the standing sprinter's start and the moving start was the reason these two techniques were selected for investigation in this study.

Statement of Significance

Very little scientific evidence exists to support any previous theories on the subject of starting techniques in baserunning for softball. The purpose of this study was to determine if there was a difference between the moving start and the sprinter's start when breaking from a base in softball. Evidence suggesting preference of one method over the other, could alter the way fast-pitch softball is played and coached in the future.

If evidence suggests one of these two methods to be superior to the other, continued research can be done. Once a scientific base line is set, others can repeat studies or perform similar studies to further refine the research findings.

Physical educators, coaches and athletes from all levels of softball competition can use this research to better understand the intricacies of the methods and techniques they use to teach the game of softball. Recreational softball players may also benefit from such research by using the information to improve his/her ability to play the game.

Substantive Hypothesis

The null hypothesis in this study stated there was no significant difference in the time it takes groups coached in different starting methods to move a prescribed distance using the moving start and the sprinter's start.

The alternate hypothesis stated that the time it takes a runner to move a prescribed distance using the moving start

will not be equal to the time it takes using the sprinter's start.

Statistical Hypothesis

$H_O = \gamma_A = \gamma_B = \gamma_C$

$H_A = \gamma_A \neq \gamma_B \neq \gamma_C$

Assumptions

The following assumptions are accepted to form a basis for the study.

1. The ability of subjects was randomly distributed between all three groupings.
2. All three groups were equally motivated.
3. The individuals that taught the starting techniques did so with equal efficiency.

Definition of Terms

To help the reader better understand this report, the following definitions are suggested.

1. Reaction Time - The time elapsed from the presentation of a stimulus to the first sign of movement.
2. Response Time - The time elapsed from the presentation of a stimulus to the completion of the task.
3. Movement Time - The time elapsed from the first sign of movement until the completion of the task.

4. Organized Softball - Any form of competitive softball which makes use of rules, umpires, and coaches. It may include recreation or church leagues, ASA, AAU, or USSSA slow pitch competition or high school competition.
5. Stance - The initial preparatory body position taken by the baserunner.
6. Motion - The action of moving or changing of place or position (Stein,1982).
7. Movement - The result or action of moving (Stein, 1982).

Limitations

In a study of this nature there are certain factors that are beyond the control of the experimenter. These factors are listed below:

1. The participants must be scheduled for the training programs around their daily schedules including classes, work and other activities; therefore, physiological differences could not be controlled.
2. The total available sample pool of subjects was a limited number.
3. It was not possible to determine the previous experience of subjects with regard to their running ability.
4. The motivational level of each subject was not controlled.

Chapter 2

REVIEW OF LITERATURE

Only recently have researchers begun to investigate the differences between baseball and softball, as well as the differences between slow and fast-pitch softball. Many similarities do exist between these different games. However, in order to play a game at the most competitive level possible, the most efficient means of performing a skill must be learned. One area of interest relevant to the game of fast-pitch softball is that of baserunning starting techniques. Which technique is most efficient at getting a runner off one base and on her way to the next has yet to be determined. This chapter reviews five different areas: 1) the history of softball, 2) starting techniques, 3) biomechanics of baserunning, 4) factors related to movement and reaction time, and 5) the summary.

History of Softball

The concept of ball throwing as a sport has been practiced since the times of the early Greeks. Softball, like many of the other highly technical sports enjoyed today, originally developed from these early games (Meyer & Schwarz, 1947). The game of softball is considered to be an adaptation of baseball. If one technically considers its origin, softball history began out of the many forms of English children's sport which were

transferred to America in the seventeenth century. It is out of these sports, baseball is believed to have evolved (Zeigler, 1979).

As a descendant of baseball and an outgrowth of a number of other games, softball got its start at the Farragut Boat Club in Chicago, Illinois, in 1887 (Jones & Murray, 1978). George W. Hancock is credited with the original development and organization of the game (Vannier & Poindexter, 1960). As a natural outgrowth of baseball, it is believed softball was developed for some of the same reasons that basketball was - the need for a team game which could be played in a relatively small area and indoors (Humiston & Michel, 1965).

The indoor game was very popular because it offered a competitive experience to participants, was inexpensive, and could be played in small areas. The original game of "indoor baseball" was played with a boxing glove for a ball and a broom for a bat. Hancock provided the game with some organization by devising rules and providing a ball larger and softer than a baseball and a bat with a small head (Jones & Murray, 1978).

Gymnasiums of colleges and universities and Young Mens Christian Associations (YMCA) were initially used for playing the game (Jones & Murray, 1978). Recreation groups soon moved the sport outdoors under the title of playground ball where it gained its greatest popularity as a sport suitable for both men and women (Vannier & Poindexter, 1960). One of the major problems of the game at this time was the many variations.

Dozens of different playing and eligibility rules were used all over the country (Joyce & Anquillare, 1975). Even the name was not standardized. Such things as playground ball, twilight ball, kitten ball, mush ball, pumpkin ball, diamond ball, and indoor baseball all referred to some form of the modern day game of softball (Humiston & Michel, 1965). This new game was given the name of "softball" in 1921 by Walter Hakanson when it was introduced in a Denver YMCA. In 1932, this name became official (Humiston & Michel, 1965).

In 1933, the Amateur Softball Association (ASA) and the International Joint Rules Committee on Softball were organized (Joyce & Anquillare, 1975). The primary objective of these two organizations was to standardize the rules by which the game was played and to develop national unity.

Up until this time, softball was only recognized as a sport in the United States. World War II is credited with the development of softball in areas outside the United States. Jones and Murray (1978) noted that American servicemen played the game wherever they were stationed and in doing so introduced it to local populations throughout the world. As people around the world learned the game, its popularity grew, so much so that softball is now recognized as part of the Pan American and Asian Games (Backus, 1979).

Since its inception, softball had always been played as a fast-pitch game. In the early 1950's, the game of softball developed a different look. Slowpitch softball was introduced. It became popular so fast that a national tournament for men

was held in 1953 (Jones & Murray, 1979). Fast-pitch softball continues to be the most popular game at the international level today. However, Joyce and Anquillare (1975) feel if the growth of slow pitch softball in the United States is any indication of the future, it won't be long before slow pitch spreads to other countries.

It is now estimated that over 26 million people participate per year in some form of softball, recreational or competitive, in the United States alone (Backus, 1979). On the international scene, softball is now played in some 50 countries on a competitive level. That figure produces some thirty-six million participants in countries excluding the United States (Jones & Murray, 1978). Softball is a game everyone, adults and youngsters alike, can play. Based on these statictics, softball today is considered the most popular team participation sport in the United States (Backus, 1979, Jones & Murray, 1978).

Starting Techniques

The first and foremost objective of a baserunner is to move from one base to another, or around one, two, or three bases, as quickly as possible (Mushier, 1973). In analyzing the three components of organized softball - baserunning, hitting, and defense - it is baserunning which is most often overlooked in a team's development (Kesler, 1982).

Experts agree that of all the skills required to play the game of softball, baserunning is the most neglected (Benedetti, 1981).Coaches and teachers spend hours teaching the fundamentals of batting and fielding but often devote little time to the techniques and philosophies of good baserunning. Meyer and Schwarz (1947) suggested baserunning is an important component in the offense of a team and should not be neglected when practicing the fundamentals of softball.

Baserunning is most important in contributing to the big offensive innings as well as breaking up the decisive late-inning rallies (Kesler, 1982). Of the skills required in softball, baserunning can be the most satisfying. However, players must learn to be aggressive and challenge their opponent continuously. Nothing is more threatening to an opponent then a speedy and clever baserunner (Meyer & Schwarz, 1947).

The best teams in softball recognize baserunning as an intregal part of the game, one that requires concentrated fundamental practice and one that can ultimately separate average teams from good teams (Kesler, 1982). If a team works hard on this important aspect of the game, it will gain a tremendous advantage over any opponent. As the level of competition increases, the team that runs the bases aggresively will, in the long run, score many more runs than the team which runs the bases conservatively (Wenk, 1984).

Parkes (1962) noted that if the game of softball is to be understood, enjoyed, and played at the highest competitive

level possible, strategies must also be taught along with the rules and skills. It is not simply enough for an individual to know how to perform the skills of the game properly, they must also understand the concept behind each skill. Beginning players should start by learning the simple and elementary aspects of strategy in the game. As a player becomes more advanced she can apply more complex elements to her play.

Included in the development of a strategy is the skill of baserunning. A good starting technique determines the success of baserunning. One must determine the type of starting technique to be utilized. A simple observation of any softball game will show that runners do not use one method over another. Baize (1980) also feels that the takeoff from the base is the most crucial aspect of proper baserunning and should therefore by emphasized when teaching this skill.

Exceptional speed is a definite asset in attempting to steal a base, but average speed combined with good timing and know-how can also accomplish the same thing (Whitmore, 1955). Sprinters usually will not reach their maximum speed until 40 to 60 yards from the start. Because the bases in softball are only 60 feet apart, great emphasis must be placed on the start. Stevens (1981) believes the base is really stolen in the first 30 feet. Ryan (1981) however, disagrees with Stevens and believes most bases are stolen in the first twenty feet. Getting a fast start is important regardless of the distances needed to steal a base. If a quick runner uses the proper starting technique, she will steal the base regardless.

In fast-pitch softball, a baserunner is not allowed to leave the base until the pitcher releases the ball (King, 1984). It is important however, that a runner get a good jump off the base. As Baize (1980) noted earlier, the takeoff from a base is the most crucial aspect in baserunning. By getting a good jump, a runner improves her chances of making it safely to the next base (Wenk, 1984).

It is generally believed there are four different starting techniques used as a means of breaking from a base - the sprinter's start, the moving start, the cross-over step start, and the jab-step start. Depending on the preference of the player or coach, any one of these techniques may be used. Research has yet to establish that one of these starting techniques is clearly superior to the others. The placement of the feet on the base is the major difference when comparing one starting technique to another.

The Sprinter's Start

The first of these starts, the sprinter's start(Appendix G), involves a runner assuming a position on the base which is similar to that of a runner coming out of the starting blocks in track (King, 1984). The hips and shoulders of the runner are facing the base to which they are attempting to advance (Day, 1955).

The sprinter's start begins with the runner in a crouched position with her trail foot on the lead side of the base (King, 1984). Her lead foot is approximately one step in front of the base and in line with the base to which she is

advancing. A runner's toes and knees should also point directly toward the next base so no energy will be wasted as she pushes off (Drysdale & Harris, 1982). If the toes and knees are out of line, the push from the base will be in a direction which is not desirable for the most efficient start.

The runner's weight should be forward and resting on the balls of both feet with the heels in an upward position (King, 1984). With sufficient body lean toward the next base, a runner is better able to shift her center of gravity off balance and in the desired direction (Israel & Brown, 1981). If her weight is equally distributed, valuable time will be lost because her first move would have to be getting the body off balance. Regardless if a runner's weight is centered or forward, the body must be shifted off balance to create movement. The key concept in having the weight forward is the amount of distance the weight must be shifted.

Drysdale and Harris (1982) noted that the position of runner's head is the only thing which is not facing the next base. It should be turned slightly with eyes focused on the pitcher as she presents the ball and begins her delivery. The head is also turned so that the runner may see anything which takes place in the pitcher-batter exchange (Meyer, 1984). As the pitcher begins her windup, the runner extends her back leg and begins to move her center of gravity forward (Drysdale & Harris, 1982). Finally, she pushes off with both feet simultaneously and brings her trail foot forward (Israel & Brown, 1981). To aid in acceleration, a runner may use short

strides as well as pumping the arms until top speed is attained.

The Moving Start

A second style which is very similar to the sprinter's start is the moving start (Appendix G). This method places the runner in motion at the time the ball is released by the pitcher (Acampora, 1986; Kneer, 1987). The runner assumes a position similar to that of the sprinter's start with the exception of the foot placement.

A runner positions her feet so the lead foot is on the edge of the base toward the next base and the trail foot is a step behind the base in foul territory (Steilein, 1980; Ryan, 1981; Acampora, 1986; Day, 1955; Wenk, 1984). Most experts agree that the left foot should be the lead foot and the right foot the trail foot because more people are right handed therefore making their left foot the dominant one (Israel & Brown, 1981). Johnson (1984) indicated the placing of the lead foot on the base should be on the outfield or right side of the base. This is done so the right foot will clear to the side of the base as it swings forward.

The runner's weight should be evenly balanced but centered behind the base (Day, 1955; Drysdale & Harris, 1982). As the pitcher begins her delivery the runner's weight should shift to her trail foot (Wenk, 1984). When the pitcher's arm comes forward and down, the runner's weight shifts over the lead foot allowing the trail foot to take a step (Meyer, 1982; Day, 1955; Ryan, 1981). Finally, as the pitcher releases the ball, the

runner should be landing on her trail foot , which has now become the lead foot, with her body already in motion (Acampora, 1986; Stevens, 1981; Kneer, 1987; Israel & Brown, 1981). It is important to note that a runner should not "pop up" when leaving the base. Momentum can be built faster by keeping the body low and as horizontal as possible (Drysdale, 1982). To accomplish this, the push from the base should be out towards the next base, not up into the air (King, 1984).

The Cross-Over Step Start

A third type of starting technique which can be used is the cross-over step start. This method involves a runner assuming a position which is similar to that used in baseball. A runner's foot position is the key component which distinguishes this technique.

A runner will assume a position on the base with the outside edge of her left foot touching the lead side of the base (Johnson, 1984). The arms hang freely down and away from the body to aid in balance and a quick shift of body weight (Vannier & Poindexter, 1960). Feet are shoulder width apart and the weight is on the balls of the feet.

As the ball is released by the pitcher, the runner rotates on the balls of her feet and steps across the right foot with the left (Israel & Brown 1981). As she steps, she must also rotate the upper portion of her body. This is done by flexing the left arm simulating a left uppercut (Israel, 1980). After the cross-over step is taken and the body is rotated, it will be in a position facing the next base. The runner will then

continue her motion in a forward direction as she would if using the moving or sprinter's start.

The Jab-Step Start

The final type of starting technique which a runner may choose to use is the jab-step start. It is identical to the cross-over step start with one exception. Instead of a runner initiating movement by stepping across her right foot with the left, she steps toward the next base with her right foot as she pivots on the ball of her left foot (Israel, 1976). As she continues to run toward the next base, the left foot crosses over the right putting her body in a position facing the next base (Israel & Brown, 1981).

Comparison of Starts

Research has shown that no one technique is superior to the others. The literature indicates though that the moving start seems to be preferable. Israel & Brown (1981), Acampora (1986), Ryan (1981), Drysdale & Harris (1982), Stevens (1981), and Kirby (1981) are in agreement.

When using the moving start, a runner's body will have momentum in the direction of the next base yet still be in contact with the base until the pitch is released (Backus, 1979). From a biomechanical view, this start is believed to be the best because the runner pre-stretches her muscle as she moves her leg back thereby increasing the force of the shortening muscle contraction (Stevens, 1981). The more force a runner can exert, the greater the power of contraction as she pushes off and strides forward. Another advantage of the

moving start is the added pressure it puts on the defense because the start can be deceptive (Jones & Murray, 1978).

There are some disadvantages to using the moving start as well. A major problem when first using such a start is the considerable practice it takes to develop proper timing because a baserunner cues her start off the pitchers motion and release of the ball (Drysdale & Harris, 1982). A second disadvantage is that umpires tend to call the runner out for leaving the base too early.

When comparing the moving start to the sprinter's start there seems to be one disadvantage of the latter. Because the body must take an extra stride to get momentum started, Ryan (1981) felt this method was inferior. A strong argument can also be made for the disadvantage of the sprinter's start if a runner must quickly return to the base. As reported by Meyer (1984), after a lead has been taken with this stance, the body has to be turned approximately 90 degrees so that the runner can best move laterally back to the base. It is felt that this turn, which must be made, will take too much time and a runner could be picked off.

The jab-step and cross-over step starts, which are predominantly used in baseball because runner's are allowed to lead off, have only one advantage in softball. They allow quick lateral movement which is of key importance if there is a need to return to the original base (Meyer, 1984). A major disadvantage of such a start is that the runner has to pivot her hips and turn her shoulders square to the next base as the

pitcher releases the ball (Acampora, 1986). This may take precious time away from the steal.

Biomechanics of Baserunning

Wnenever a coach speaks about studying or examining a player's motion of a particular skill, they are really talking about looking at the biomechanical aspects of the sport. The term biomechanics refers to the utilization of applying the scientific principles of physics in order to better understand the movement and actions of the human body (Bucher, 1983).

The field of biomechanics is basically concerned with two major areas of study. The first of these areas involves the biological aspects of the human body including the muscular and skeletal systems. Such things as the force applied to bones, contraction of muscles, and nerve impulses to cause movement are all involved in this area. The second area of study utilizes the laws and principles of Newtonian physics and applies them to human motion and movement. The law of inertia, acceleration, and action are the major focus of this area.

As technology becomes more advanced, so too does the level at which skills are learned and perfected. This creates a need for physical educators, coaches, and even athletes to better understand the subdisciplines which provide the scientific foundation on which this profession rests. In order for a coach or physical educator to be successful they must use all the knowledge and resources available to them. Biomechanics is one area which can offer the scientific knowledge necessary to improve an individual's performance (Bucher, 1983).

Baserunning is a skill which involves motion or movement. The forces which must by applied to the body in order to start it in motion, change directions, or stop it all relate to the laws of Sir Isaac Newton. These laws make it possible to better predict the motion of an object.

Newton's first law, the law of inertia, states that an object in motion or at rest will remain in motion or at rest unless acted upon by an external force (Broer, 1966). In order for movement to occur, a force must be sufficient enough to act on the object and overcome it's inertia. Once the object is in motion, less force is required to maintain that speed. It would make sense then, that the greater the use of momentum to attain a given speed, the less energy it requires. Based on the summarization of Newton's first law, it would appear then that a baserunner stands a better chance of stealing a base if she can be in motion before the pitch (Bunn, 1955).

The other law of Newton's which applies specifically to baserunning is the third law. It is known as the law of action or reaction and states that for every action force there is an equal and opposite reaction force (Barham, 1978). Whenever one object moves, another object will move too; however, it will move in the opposite direction. When the body moves, the force applied upon the supporting surface or other object will develop a force equal to and opposite that of the original force. Based on Newton's third law then, it would appear that a baserunner should push against the base with the greatest force possible in order to receive an optimum force back from the base.

In starting from a base, the emphasis is on getting away from the base as quickly as possible and into a position which is favorable to developing the desired speed in the shortest distance (Bunn, 1972). It would stand to reason that the ideal starting position is one which will permit the greatest force over the longest distance but in the shortest time. To accomplish this, a runner positions her weight so it is the least stable in the direction she wishes to run. This will allow her the quickest possible start.

When a runner assumes her position on the base, she must make sure she is lined up in the direction she wishes to run. As Newton's third law states, the force produced by the body must be applied in the direction opposite to the desired movement (Broer, 1966). If she is not lined up, energy will be wasted in an unwanted direction.

Also important to a runner is her ability to get to full speed as quickly as possible. Bunn (1972) stated that a runner could attain her top speed in about 30 feet. In order for a runner to do this, she should reduce the length of her strides so foot-surface contact will be more frequent (Jensen, 1977). Because a runner can only gain speed while her feet are in contact with the ground, she takes short strides when acceleration is needed and gradually increases her stride until she reaches her top speed. These simple but important biomechanical factors of running may greatly improve an individual's success if they are employed. They may make the difference of a runner being out or safe.

Factors Related to Movement and Reaction Time

No matter what the skill or sport being investigated, one thing holds true in all cases, the athlete must be able to respond quickly to conditions around her. If she is not able to do this, she may not have as much success as a fellow athlete. One of the most important behavioral charateristics of an individual is the speed at which he/she reacts to a stimulus (Robb, 1972). Oxendine (1986) suggests that this component alone seems to be the most distinguishing characteristic which separates the outstanding, average, and poor performers in many motor skills.

There are three terms which are generally used when talking about the speed at which an individual reacts to stimulus. The first of these, reaction time, is the elapsed time from the presentation of a stimulus to the initiation of response (Phillips & Hornak, 1979). Movement time, the second component, is the amount of time it takes to complete the actual response after it has been initiated (Robb, 1972). The total time taken to initiate and complete a response is known as response time (Oxendine, 1968). These three components of speed are often measured and used as a means of determining differences which may exist among athletes.

Coaches have traditionally believed that the best athletes are those who have the fastest reaction time (Oxendine, 1968). In athletics, an individual is often required to make a response in one of several directions without prior knowledge of that direction (Loockerman & Berger, 1972). By studying

athletes and determining which of them have the ability to react most rapidly, coaches are better able to maximize the potential of an athlete as well as the team. In all sports today there are athletes who have very specialized roles on the team. The sport of softball is no exception. Players can be divided into infielders or outfielders or by the positions they play in the infield or outfield. Individuals who play a position such as first or third base usually do so because they are quick and agile. They are given this role on the team because of their ability to react very quickly to a stimuli or different conditions that arise during a game. For this reason, it would seen valuable to know how individuals react and respond to different stimuli under different conditions (Colgate, 1968).

When examining an individual's reaction and movement time for a specific sports skill, one must break these two components down and evaluate them independently. As Pierson (1959) suggested however, research has yet to show if there is a positive correlation between the two. Reaction time is thought to be a function of the central processing unit (Robb, 1972). It is during this phase that an individual must process the information, the stimuli, and then react to it by sending a message from the brain to the correct muscles. This takes very little time to do as long as the information to be processed isn't too great. Robb noted that the more information a person must process, the longer the reaction time.

Individual variables such as motivation, amount of practice, and sex and age of a person all affect an individual's reaction time and movement time. However, the major components of movement time are believed to be an individual's muscular efficiency, strength, and endurance (Phillips & Hornak,1979). If this is true, as research has indicated, then it would seem that improvements can be made in an individual's movement time through practice. Phillips and Hornak reasoned that as a skill is developed, the time necessary to perform the task will decrease.

With little correlation being found between reaction time and movement time, one can conclude that the ability to react quickly and the ability to move quickly are unrelated and therefore should be studied as such. Guilford (1958) supports the idea that these two components should be studied separately because he feels reaction time is something which is inherited and therefore cannot be changed; whereas, movement time is something which is developed and will change as a person becomes more proficient at a skill. By examining baserunning starting techniques to determine the most efficient one and then perfecting that technique, an individual will be able to decrease her movement time between bases.

Summary

The game of softball is originally believed to have evolved out of the game of baseball in the late eighteen hundreds. George W. Hancock developed and organized the game to satisfy

the need for a game which could be played indoors, was inexpensive, and could be played in a relatively small area. As its popularity grew, the game was moved outdoors where it became a sport suitable for both men and women to play.

Today it is estimated that over 26 million people participate yearly in some form of softball in the United States alone and another 36 million in other countries. At the international level, over 50 countries now compete on a competitive level. Because softball is a game which can be enjoyed by people of all skill levels, it is considered the largest team participation sport in the United States.

With such a high level of participation also comes the need to improve the skill level at which an individual plays. There are four different starting techniques which are generally used in softball as a means of breaking from a base - the sprinter's start, the moving start, the cross-over step start, and the jab-step start. The placement of a runner's feet on the base is the major difference between all of these starts. Research; however, has yet to show that one of these starting techniques is superior to the others.

The first two starts, the sprinter's start and the moving start, are very similar with one exception. When using the sprinter's start, a runner places her trail foot against the lead side of the base. Her other foot is placed one step in front of the base and in line with the base for which she is attempting to advance. Using the moving start places the lead foot of the runner on the lead side of the base while the trail

foot is a step behind the base in foul territory. This method allows the runner to push off with her trail foot and start advancing to the next base while the pitcher still has the ball.

The other two starts, the cross-over step start and the jab-step start, are similar to each other but different than the previously discussed starts. These starts involve a runner assuming a starting position which is like the one used in baseball. The runner places her feet shoulder width apart with the outside edge of her left foot against the lead side of the base and her body facing the infield. Using the cross-over step start, the runner rotates on the balls of her feet and steps across her right foot with the left. Implementing the jab-step start finds a runner assuming the same starting position; however, instead of crossing her right foot with the left to initiate movement, she steps with the right foot towards the next base as she pivots her left foot.

By examining Newton's first law and relating it to baserunning, it appears a runner will stand a better chance of stealing a base if she can be in motion at the time the pitcher releases the ball. A baserunner must also apply the greatest possible force against the ground and base in order to receive the optimum force in return. This idea is based on Newton's third law.

Another important concept related to the success of baserunning is how quickly an individual can respond to a situation. Two components which combine to make such a

response are reaction time and movement time. Reaction time is defined as the amount of time elapsed from the presentation of a stimulus to the first sign of movement. The second phase of movment is defined as movement time. It constitutes the time from the first sign of movement to the completion of the skill. Using these two components to measure speed, one can often determine differences which exist among athletes.

When examining sport skills, both reaction time and movement time must be considered. These two components are generally evaluated independently. Reaction time is something which is believed to be inherited and cannot be changed; whereas, movement time is developed as a person betters her ability to perform a skill. In skills such as a baserunning starting technique, the more an individual practices, the lower her movment time will become. As a final means of reducing her reaction time, an individual should use the starting technique which has been shown to be the most efficient when breaking from a base.

Chapter 3

RESEARCH AND METHODOLOGY

The purpose of this study was to determine which starting technique, the moving start or the sprinter's start, was most efficient. This chapter is divided into four sections: 1) population and sampling, 2) design of the study, 3) steps and procedures, and 4) statistical design.

Population and Sampling

The subject pool for this study consisted of students enrolled in Lifetime Fitness classes at Emporia State University during the spring semester of 1988 who were inexperienced in playing the game of softball. A questionnaire was used to determine the amount of playing experience a subject had (Appendix D). In order for a subject to be considered inexperienced, she must not have played varsity softball at the college or junior college level, or any type of organized softball within the past three years. If a subject has had a limited amount of coaching and instruction, her general knowledge and ability of base stealing techniques will be limited. Inexperienced subjects were used so any changes between pretest and posttest results could be attributed to the starting technique itself. If a two week training program could show that one technique was superior to another after being learned, it could be assumed that that technique was the most efficient.

The population consisted of forty-eight college aged females all of whom volunteered for the study. Once the subjects were determined, each was assigned a serial identification number. This number was used for the process of assigning subjects to either one of the two experimental groups or the control group.

Using a random numbers table (Glasnapp & Poggio, 1985), forty-eight numbers were generated which could be matched back to the identification numbers of the subjects. Subjects were drawn in three member sets, with the first three randomly chosen subjects placed in the first set. Three pieces of paper with control group, experimental group A, and experimental group B written on them were placed in a hat. The first piece of paper drawn out of the hat placed the first subject of the set in the group stated on the paper. The second piece of paper placed subject two in the group designated on the paper. The third subject was then placed in the remaining group. The three pieces of paper were then returned to the hat. Random numbers four, five, and six were then matched to the next three subjects. Once again a piece of paper was drawn out of the hat to place subject four in one of the three groups. The second piece of paper drawn out placed subject five into a group with the last piece of paper in the hat placing subject six into the remaining group. Each group, the control group, experimental group A, and experimental group B, had two subjects in them after this process had taken place. The above process was continued until all subjects had been assigned to a group. When the selection process was completed, each group contained

sixteen subjects. The dual randomization process was used to eliminate any sampling bias that may have existed.

Design of the Study

The research methodology chosen for this study is quasi - experimental. The purpose of this research method is to confirm or deny a hypothesis based on comparison and contrast of two or more variables in a controlled setting. It is especially common in behavioral research with human subjects because it allows for a relaxation of sampling considerations, and recognizes the complexity of the human condition. Humans, unlike other species, have a much higher level of thinking and are often unpredictable and difficult to study. An individual's behavior is also very uncertain and is usually dependent on the situation at hand. Because of these two factors, behavior and the level of thinking, the study of human beings is complex and exhausting.

The experimental design implemented was a randomized control - group pretest - posttest. The study involved a control group and two experimental groups established as outlined above.

A pretest was given to both experimental groups and the control group with subjects using any style of starting technique they wish (Detailed in the "Steps and Procedures" section of this chapter). The experimental groups were then exposed to a seven day training program covering one of the starting techniques being examined. Experimental group A was taught the moving start, while experimental group B was

instructed in the sprinter's start (Detailed in the "Step and Procedures" section of this chapter). During this training period, the control group received no treatment. As a final step in this research design, a posttest was given to each group. This test was identical to the pretest except, experimental group A used the moving start, experimental group B the sprinter's start, and the control group the technique of their choice.

To insure internal validity existed, both the control and experimental groups were tested by a confederate. Treatment of experimental groups was done independently. Group A worked exclusively with the experimenter on one of the starting techniques being investigated while experimental group B worked with a second confederate, who had a softball and coaching background similar to the researchers, on the other starting technique. As a final measure to guarantee the existence of internal validity, the dual randomization process was used to assign subjects to one of the three groups. Thus, all subjects were both randomly chosen from the total sample pool and also randomly assigned to a treatment condition.

External validity was obtained by selecting subjects for this investigation in such a manner that results could be generalized to coaching techniques utilized in working with softball players of all ability levels. The individuals potential to benefit from learning the technique being investigated was seen as a difference in their ability to execute the skill effectively.

Steps and Procedures

The subject pool for this study consisted of female students enrolled in Lifetime Fitness classes at Emporia State University during the spring semester of 1988. The experimenter asked the instructor of each class for permission to address his or her class to solicit volunteers (Appendix C). After the announcement was made asking for volunteers, the student was told to either notify her instructor or the experimenter if she was willing to participate. Those students who volunteered were asked to fill out a questionnaire regarding their general health (Appendix D). Five subjects were over thirty-five years of age and needed written consent from a physician before being allowed to participate (Appendix E).

Subjects were assigned to the control group, experimental group A, or experimental group B as was previously described. Each group contained twenty subjects when the selection process had been completed.

All testing and training took place in the gymnasiums at Emporia State University. The treatment lasted for a total of nine days. Each subject scheduled times that she could individually meet with the experimenter seven of those days for a total of thirty minutes each day. The only subjects who did not meet all nine days were those who comprised the control group. They met with the experimenter only two days, once at the beginning and once at the end of the experiment.

On the first day of the testing, subjects were asked to sign an informed consent form before any part of the experiment

could take place. It stated clearly the stipulations of the experiment as well as any risks involved (Appendix A). After this form had been signed, the experiment began. If a subject could not for some reason continue with the study, or if she failed to complete the required training program, she was dropped from the study and her data was not used.

During the first session, all subjects were pretested on the base- running starting technique of their choice. The time of day of each subject's pretest was determined based on her availability and the experimenters availability during the day. Subjects were asked to wear a t-shirt, comfortable shorts, and tennis shoes to all sessions. Before any testing was done, subjects met in a designated gym at Emporia State University and were taken through a series of flexibility exercises to ensure that the various muscle groups to be utilized were stretched (Appendix F). They also performed various jogging exercises as a final measure to make sure they had warmed-up thoroughly. At the conclusion of the testing, subjects were again led through a series of various flexibility exercises to cool the body down.

The time it takes for a runner to leave one base and arrive at a prescribed distance was measured using a Dekan Automatic Performance Analyzer. An 18 inch by 30 inch mat was used both to start and stop the timer. A subject took a starting position on a base just as she would in a game situation. This position was one of her choice. No instructions were given to correct her technique.

The subject then watched the pitcher as she assumed a position on the pitching mound. The pitcher's front foot was centered on top of an 18 by 30 inch mat. The pitcher was a member of the women's softball team at Emporia State University and was used for all subjects. Subjects were informed that they must wait until the ball left the pitcher's hand before they could leave the base. Subjects then prepared themselves to leave the base on the release of the ball from the pitcher's hand. As the ball was released and the pitcher lifted her foot off the mat, the time began. The subject then pushed off the base and run as fast as she could for a distance of thirty feet(Appendix B) where she touched another 18 by 30 inch mat to stop the time.

The subjects were given three practice trials which were not timed to make sure they understood what was being asked of them before timed trials were performed. The experimenter then positioned herself behind first base in foul territory and at such an angle that both the pitcher and the runner on base could be seen (Appendix G). From this position, the experimenter made sure all trials were legal and provided feedback to the subjects if corrections had to be made.

Leadoff violations occured when a runner leaves the base before the pitcher releases the ball. These were also called by the experimenter. If a violation occured, the trial did not count and the subject had to repeat it until it was done legally. Once the experimenter was satisfied that the subject was competent at performing a starting technique, three trials were given with times being recorded by a confederate.

The times of a subject's three correct trials were averaged to get a single score. This score was then compared to a score which was obtained after the seven day training program. Leadoff violations were also counted for each starting technique used by subjects.

On days two through eight, subjects in experimental groups A and B were put through training sessions on starting techniques chosen by the experimenter. The teaching method to be used in the training sessions for both starting techniques was standardized by the experimenter and the second confederate (Appendix H). The control group remained idle during this period and was not subjected to any practice or learning.

Experimental group A participated in a training program covering the moving start technique on days two through eight. The teaching and training of subjects was done exclusively by the experimenter. She worked only with this group and had no contact with the other groups during this period. A total of seven sessions were given for a subject to learn the desired technique. Subjects attended a thirty minute session three out of seven days each week for a total of six sessions. The seventh session consisted of all members in the experimental group meeting at the same time. Training sessions were set up at the subjects convenience and were held in the gymnasiums at Emporia State University.

On day two of the study, all subjects in group A met with the experimenter at the same time. They were led through a variety of flexibility and jogging exercises as a warm-up to

prepare for the training session (Appendix F). At the conclusion of the warm-up, the experimenter then explained the moving start technique to the group and demonstrated the proper way to perform it. Subjects were then placed in three rows along the wall of the gym. They assumed the proper position as if they were standing on the base. The experimenter then corrected any stances which may have been wrong and offered advice to subjects on the performance of the technique.

When the experimenter was satisfied that all subjects fully understood and could demonstrate the proper stance, practice trials took place. The experimenter assumed a position as a pitcher so the subjects could watch her pitching motion and learn the proper timing. On the command "ready", subjects in the first row rocked back onto their trail foot and on the command "go" they pushed off with their trail foot and ran for thirty feet in the direction of the next base. Feedback was provided to runners who incorrectly performed the start as well as to those runners who performed it correctly. After subjects in row one had received feedback on their performance, subjects in row two assumed the stance and waited for the "ready" command. As the experimenter gave the commands "ready" and "go", subjects performed the moving start just as subjects in row one had done. Feedback was again provided to subjects for both correct and incorrect performances. Finally, subjects in row three performed the moving start in the same manner as the first two groups did. This process was repeated until each subject had performed the technique ten times. At the

conclusion of the ten trials, subjects were again led through various flexibility exercises as a means of cooling down.

On days three through eight, subjects met with the experimenter to practice the moving start technique. Subjects came in for a period of thirty minutes and individually worked with the experimenter. The first five minutes was used for a warm-up and consisted of flexibility and jogging exercises (Appendix F). The next twenty minutes was spent working with the subject on the moving start technique. She then performed the start in the same manner as she did as on day two. A total of ten starts were taken with a minute and a half rest between each (Appendix B). Feedback was provided on her performance by the experimenter. The remaining five minutes of the session was used for a cool-down and consisted of flexibility exercises (Appendix F). A total of seventy practice trials were taken over the nine day training program before subjects were again tested on the learned technique.

Experiemental group B also participated in a training program on days two through eight. They, however, learned the sprinter's start technique taught exclusively by a confederate. The confederate had no contact with members of any other group except group B. The training process used for experimental group A was exactly the same for experimental group B with the exception of the technique being taught. Subjects attended training sessions thirty minutes long each day consisting of a warm-up, instructional time, and cool-down (Appendix H). A total of seventy trials took place during the nine day training program before subjects were tested on the learned technique.

On day nine of the study, subjects from the control, experimental group A, and experimental group B were again tested. The posttest was identical to the previously discussed pretest except experimental group A used the moving start; experimental group B used the sprinter's start; and the control group used the technique of their choice. The time of day of each subject's posttest was again determined based on her availability during the day. Subjects were given three practice trials which were not timed. Once the experimenter was satisfied the subject fully understood what was being asked of her, three timed trials were given. Leadoff violations were again called by the experimenter. A subjects score was calculated by obtaining the average time of three correctly done trials.

Substantive Hypothesis

The null hypothesis in this study stated that there was no significant difference in the time it took groups coached in different start methods to move a prescribed distance using the moving start and sprinter's start.

The alternate hypothesis stated that the time it takes a runner to move a prescribed distance using the moving start will not be equal to the time it takes using the sprinter's start.

Statistical Hypothesis

$H_0 = \gamma_A = \gamma_B = \gamma_C$

$H_A = \gamma_A \neq \gamma_B \neq \gamma_C$

The null hypothesis stated that the time it takes to move a prescribed distance using the moving start, the time it takes using the sprinter's start, and the time it takes subjects of the control group using the technique of their choice would be equal.

The alternate hypothesis stated that the times would not be equal.

If the null hypothesis is rejected, one can accept the alternate hypothesis. If this is the case, appropriate subanalysis would be perfromed to isolate these differences.

Statistical Design

To perform a statistical analysis of difference between pretest and posttest scores for each group, a one by three way ANOVA was performed. The Statistical Analysis System (SAS) statistical package for the computer was used to complete this analysis.

Summary

This study was designed to determine which starting technique would allow a runner the quickest and most efficient

method of leaving a base. Forty-eight subjects were selected from volunteers enrolled in Lifetime Fitness classes at Emporia State University. They were then randomly divided into three groups of sixteen subjects each.

The subjects who comprise the control group participated in the pretest and posttest only. Experimental groups participated in a training program three out of seven days each week for thirty minutes a session. The training program lasted two weeks with one group practicing the moving start technique while the other group practiced the sprinter's start.

Upon the conclusion of these training programs, a posttest was given to determine the effect of the training programs. Three trials were given to each subject with an average of the three times being figured. To determine the significance of the performance associated with each starting technique, a one by three ANOVA was used. The SAS statistical package was used for the analysis of data.

Chapter 4

ANALYSIS OF DATA

The purpose of this study was to determine which starting technique, the moving start or the sprinter's start, was most efficient. This chapter is devoted to the analysis of data obtained for the pre- and posttests given to both the control and experimental groups. For the pretest, subjects used a technique of their choice as a means of leaving the base. After the experimental groups participated in a training program, all subjects were again tested. The posttest consisted of experimental group A performing the moving start technique, experimental group B the sprinter's start, and the control group the technique of their choice.

The statistical procedure used for the analysis was an analysis of variance (ANOVA). A .05 level of significance was used. In addition, descriptive statistics regarding subjects' mean height, weight, and age were calculated to determine if the groups were relatively similar in body size and age.

Sample Analysis

The subjects in this study consisted of 48 female volunteers who were currently enrolled in a Lifetime Fitness course at Emporia State University. Three groups consisting of sixteen individuals each, were used in this study, which lasted a total of nine days. The control group subjects met with the

experimenter two of the nine days at which time they performed their pre- and posttests using any technique they wished.

On day one of the experiment, subjects in group A and B met with the experimenter to perform their pretest. Days two through eight of the experiment consisted of subjects in group A participating in a training program to learn the moving start technique. Experimental group B subjects were placed in a training program in which the sprinter's start was taught during this same period. On day nine of the experiment, subjects within the experimental groups once again met with the experimenter to perform their posttest. At this time subjects in group A used the moving start technique while subjects in group B the sprinter's start.

In addition, the mean weight, height, and age of all three groups was compared to determine if the groups were equal in relationship to the subjects body compositions. If one group had shown a much higher mean age, weight, or height scores may not have reflected a true difference between the techniques but rather a measure of raw physical differences. With results indicating the groups to be relatively equal, (Table 1) it was assumed that any significant variation scores represented a difference attributable to treatment conditions.

Table 1

MEAN WEIGHT, HEIGHT, AGE

	Weight	Height	Age
Control	134	64.5	22
Experimental Group A	139	65.0	21
Experimental Group B	138	64.5	20

Statistical Analysis

To examine the differences between the scores obtained from the experimental groups and those obtained from the control group, an analysis of variance (ANOVA) was used. This statistical technique was chosen because it allowed the experimenter to measure the amount of variance among the groups which could be exclusively attributed to the treatment effect, i.e. participation in a training program. The mean pre- and posttest scores were the variables compared in this design.

Table 2 shows a comparison of the three groups. Results indicate that group A showed the greatest change between their pre- and posttest scores.

Table 2

EXPERIMENTAL AND CONTROL GROUPS MEAN, STANDARD DEVIATION, AND DIFFERENCE BETWEEN PRE- AND POSTTEST SCORES

	Control		Group A (Moving)		Group B (Sprinter's)	
	Pre	Post	Pre	Post	Pre	Post
Mean	2.3586	2.3092	2.3057	2.1249	2.3850	2.2521
Standard Deviation	0.1815	0.1362	0.2328	0.2289	0.1485	0.1245
Difference		0.0493		0.2170		0.1661

Table 3 shows a comparison between the moving and sprinter's start with relation to the training programs.

Table 3

ANALYSIS OF VARIANCE OF DIFFERENCES BETWEEN THE MOVING START AND SPRINTER'S START MEAN VALUES

Source	Degree of Freedom (df)	Sum of Squares (ss)	Mean Squares (ms)	F-Ratio	Level of Probability (p)
Group	2	0.1415	0.0707	2.04	0.14
Error	45	1.5600	0.0350		
Total	47	1.7000			

The primary purpose of this statistical analysis was to determine if significant differences between groups existed with regard to treatment conditions. Table 3 indicates differences were found to exist at the 0.14 level of probability. This did not meet with the adopted probability level of .05 needed to infer statistical significance. Therefore, it was necessary to accept the null hypothesis $\mu_A = \mu_B = \mu_C$.

Substantive Analysis

Results of this experiment did not show that a statistical difference existed; however, substantive meaningfulness of the data should be examined. In research, it is important to remember that it is not only the statistical analysis upon which judgments are made but also the substantive analysis (Minium, 1970).

The data results, suggest that patterns did exist which would indicate the following relationships. Experimental group

A, which was trained in the moving start, showed the greatest amount of change between their pretest and posttest scores. The mean decrease in time for this group was 0.1807 seconds. In contrast to this, experimental group B decreased its mean difference between the pretest and posttest by 0.1328 seconds. The control group, as expected, improved the least between their pre- and posttest. They showed a decrease in time of only 0.0493 seconds.

This data reflects the exact outcome pattern the experimenter expected to find. This suggests several interesting areas of speculation concerning the experimental outcome. For example, the training program for the study involved the subjects within the experimental groups being given seven, thirty minute sessions, to learn the designated starting technique. During each session, the subject performed 10 starts. If the amount of starts performed in each session or the number of sessions had been increased, results may have shown a significant difference exsisted between the moving and sprinter's start techniques.

Increasing the amount of practice might have allowed subjects to decrease their posttest time. A significant difference could have resulted had this change been made in the design. Similar design considerations will be explored in the general discussion occuring in the final chapter.

Chapter 5

SUMMARY, DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS

This study was designed to determine which starting technique, the moving start or the sprinter's start, was most efficient.

Summary

Forty-eight female volunteers enrolled in Lifetime Fitness who had not participated in organized softball within the past three years served as subjects. Three groups were used, a control group and two experimental groups, with each group consisting of sixteen subjects.

A nine day training program was used to teach experimental groups A and B a different baserunning starting technique. The control group remained idle during this time. Each subject completed a pretest and posttest using a baserunning starting technique. During the pretest, subjects were allowed to use the technique of their choice. As a posttest, the control group again performed the technique of their choice while group A performed the moving start and group B the sprinter's start. The mean score of each individuals pre- and posttest was calculated, as well as the differences between means. An analysis of variance was used to study the changes between the mean pre- and posttest scores of both the experimental and control groups. This technique allowed the researcher to determine significance, based exclusively on the treatment conditions, (i.e. a starting technique training program, between groups).

On the basis of this analysis, it was determined that there was no significant difference between the experimental groups and the control groups pre- and posttest mean scores.

Discussion

Factors to consider in understanding the results include the length of the treatment time, sample size, attendance requirements, the alpha level chosen, and the composition of the groups.

Members of the experimental and control groups volunteered for this study and were given extra credit in their Lifetime Fitness class if they participated for the duration of the program. Therefore, they may not have represented the general population.

Because a baserunning starting technique was a new skill to all the subjects, it may be that the training program was not of sufficient length to allow subjects to become proficient at the skill. Subjects were required to attend a training session lasting thirty minutes, three of seven days each week, for a duration of two weeks. It is possible that both the duration and the frequency of training sessions did not provide sufficient time to bring about a change in the subjects ability to learn a new skill and perform it efficiently.

Because groups were randomly selected, it may be that the groups by chance were composed of people who had similar characteristics. Such things as personality, motivation, general physical condition, and lack of athletic experience

could all lead to an individuals performance as a subject. If an individual would have been more highly motivated or been in better physical shape, she may have been able to perform at a higher level. A change in an individuals test performance because of these factors may have led to a statistically significant difference.

The alpha level of significance chosen for any experiment is an arbitrary decision. Even though statistics are used to give direction or mathematical support to a research problem, they do not always carry automatic authority. Minium (1970) reminds us that it is the substantive application of logic that enters most importantly into judgments with regard to whether statistical significance is obtained.

Based on this interpretation, some evidence existed on the substantive level to support the alternate hypothesis. The mean changes in experimental group A's pretest and posttest scores after learning the moving start technique was consistently greater than experimental group B's means after learning the sprinter's start. This factor, along with the statistical difference found at the .14 level of probability, suggest the moving start to be more efficient after a training program was implemented and further research in this area is needed.

Recommendations and Conclusions

Although this study showed no statistical significant difference between the two experimental group's and the control group's mean changes between pre- and posttest scores, the

experimenter suggests further pursuit of this topic in the following ways:

1. A replication of this study should be done in which the baserunning starting technique training program is extended for a longer period of time. Both reaction time and movement time were examined as part of this study; however, reaction time is something which is inherited and cannot be changed, and movement time is something which is developed as one becomes more proficient at a skill. In order to decrease an individuals mean change in time between pre- and posttest scores, a study should be done which lengthens the training period so a subject may fully develop the skill being tested.
2. The number of subjects used in this study was 48 (Control = 16, Group A = 16, Group B = 16). Even though the statistical method in this study was valid, it is suggested that a larger n would improve validity.
3. A similar study should be done comparing the moving, sprinter's,cross-over, and jab-step baserunning starting techniques. These are the four types of starting techniques which could be used in softball.
4. In order to increase validity, the study should be conducted on a softball field. This would better replicate actual conditions. A study which is performed in a gym may yield results which will be inaccurate if the study is performed under true softball conditions.

Also, by performing the study on a softball field, a runner being tested will have to learn to concentrate harder on watching the pitcher because of the difference in depth perception and outside noise as compared to a gym.

5. Experience indicated that the field test results may have led to the selection of an overly conservative limitation on distance and an unnecessarily long rest period between attempts. A replication of this study should be done with baserunners running the full distance, 60 feet, between bases. Because 60 feet is used in a fast-pitch softball game, runners learn to adjust their stride so they reach the base and can round it without stutter stepping or losing a stride. Running a distance of only 30 feet did not allow an individual to attain a full stride as she approached the stop mat. If the experiment is replicated with the 60 feet distance, careful attention should be given to rest time to avoid fatiguing subjects.
6. The rest time allowed between starts should be decreased if this study is replicated using a distance of 30 feet between bases.
7. A similar study should be done using highly trained athletes, particularly softball players, as subjects. Reliability would improve because of increased knowledge of the game and a higher degree of skill. Athletes also develop instincts with regard to their particular sport

which gives them an added advantage. Retention of a skill such as baserunning would become habit faster to a softball player than to an individual who is learning a skill for the first time.

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APPENDIX A

Informed Consent Form

INFORMED CONSENT FORM

I, Janet Koenig, am asking for your participation in research designed to determine which starting technique is most efficient in getting a runner off one base and on her way to the next.

The Division of Health, Physical Education, Recreation, and Athletics strongly supports the practice of protection for human subjects participating in research and related activities. The following information is provided so that you can decide whether you wish to participate in the present study.

As a subject in this study, your presence will be required for 30 minutes, three times a week for a duration of two weeks. Three additional time slots will be arranged to facilitate the training program. The training program of this study is geared towards individuals who have not played varsity softball at the college or junior college level, or any type of organized softball within the past three years.

Each session will include a warm-up period lasting five minutes and consisting of flexibility and jogging exercises. This will be followed by a twenty minute training program which will be used to learn one of the techniques being examined. Finally, a five minute cool-down period consisting of flexibility exercises will take place. The times of each session will vary according to the subjects and experimenters availability.

Like most other physical activity, the training sessions will require some physical exertion which might induce temporary discomfort and or muscle soreness in the lower extremities. Flexibility exercises will be performed to reduce this effect. Any risk to you as a subject will be minimal.

Your permission to use the data described above is requested for the purpose of conducting research for a thesis. All data will remain confidential. Results will be presented in a manner which will not allow individual identification. Janet Koenig, the primary investigator, will possess the list matching identification numbers to the names of the participants. If you have any further questions in reference to this research study, please contact Janet Koenig at 343-1200, ext. 5930, or at home, 343-2931.

"I have read the above statements and have been fully advised of the procedures to be used in this project. I have been given sufficient opportunity to ask questions I had concerning the procedures and possible risks involved and I assume them voluntarily. I likewise understand that I can withdraw from the study at any time without being subject to reproach."

_____ _____

Date Subject

APPENDIX B

Field Test Results

FIELD TEST

A major role of subjects in this study involves the running of ten sprints at a prescribed distance. In order to determine the distance to be run and the resting time to be allowed between sprints, a field test was conducted on February 10 and 17, 1988. The test took place in gym E at Emporia State University and involved ten female subjects from a Lifetime Fitness class.

Subjects who participated ranged in age from 18-38 years of age. In addition, all subjects were considered to be of average or below average physical condition as well as being non-athletes. None of the individuals tested were participants in any form of physical activity more than two times a week or members of a varsity sports team at the University.

The field test consisted of a subject taking her own resting heart rate using the carotid pulse method. The experimenter first gave the command "ready" at which time the subjects found their pulse on their neck. As soon as all subjects were ready, the command "go" was given at which time subjects counted the number of pulse beats they felt. After fifteen seconds the subjects were told to "stop" and multiply the number of beats by four. This number then gave the individual her resting heart rate for a minute.

Before any instructions were given, a short warm-up consisting of flexibility exercises was performed. Each subject was then asked to pair up with another individual. One person would perform the test while the other served as a recorder. Roles would then be reversed so the subject who was the recorder could perform the test. After the groups had established who would run first, instructions were given to both runners and recorders as to exactly what they were to do.

On the command "ready", a subject would step to the designated line and assume a ready position to run. On the command "go", the subject ran as fast as she could to a line thirty feet away. After a period of sixty seconds the subject was told to begin counting her pulse rate and continue for fifteen seconds until she was told to stop. The subject then told her recorder that number and returned to the line to again prepare to run. The recorder multipled the pulse count by four and entered the number next to the appropriate trial on the recording sheet. After a period of ninety seconds, the subjects were again given the commands "ready" and "go" at which time they ran as fast as they could over the thirty foot distance. The process of taking a pulse was then again performed after sixty seconds with the number obtained being multipled by four and recorded. Each subject continued to do sprints until they had performed ten of them. At the end of ten sprints, the subject and the recorder exchanged roles and the above process was repeated. At the completion of this test, a cool-down involving flexibility exercises took place.

On the second day of the field test the above process was again performed with the exception of the distance run. This time subjects ran ten sprints at a distance of sixty feet with ninety seconds again being used as the amount of rest time between each sprint.

Results of this study showed that an individuals heart rate, after running ten sprints with a minute and a half rest between each one at a distance of thirty feet, increased by an average of 7.78 beats per minute. This figure is almost half the increase found after running a distance of sixty feet where the individuals heart rate increased an average of 14.64 beats per minute.

Based on the findings of this field test, the distance of thirty feet was chosen to be used in the main experiment. It was believed that having poorly conditioned subjects run a distance of sixty feet would create fatigue.

AVERAGE INCREASE IN HEART RATE AT:

	30 feet	60 feet
1.	3.6	32.8
2.	7.8	8.8
3.	9.6	29.2
4.	7.6	7.6
5.	10.0	15.6
6.	6.0	11.6
7.	21.6	17.2
8.	5.2	6.8
9.	2.0	4.4
10.	4.4	12.4
Total	7.78	14.64

APPENDIX C

Volunteer Request Statement

VOLUNTEER REQUEST STATEMENT

My name is Janet Koenig and I'm a Graduate Assistant here at Emporia State University. In order to complete my master's degree this spring, I need to do some testing for my thesis. I have asked your instructor to address you and solicit volunteers for my study.

Volunteers must be college age females who are presently enrolled in lifetime fitness. They must also be in good general health. Any volunteer over the age of thirty-five must have written permission from a physician to participate. Volunteers must also meet general requirements based on their past softball experience. People wishing to participate will be asked to fill out a short questionnaire concerning their health and softball experience.

The study will last approximately three weeks. During that time subjects will meet a total of nine days for approximately 30 minutes a session. Each session will consist of a five minute warm-up period followed by twenty minutes of instruction and practice time. Involved in the practice will be the running of ten short sprints. Recovery time will be given between practice trials so fatigue will not occur. The remaining five minutes will be used as a cool-down period with flexibility exercises to be performed.

Anyone wishing to volunteer should contact their instructor or me at 343-1200 ext. 5930 by April 1, 1988. Like any participation in a sport or activity there is a minimal risk of injury. This risk will be assumed by you as a volunteer. If at any time you become injured or do not wish to continue with the study you may drop out without suffering any consequences. No questions will be asked.

APPENDIX D

Medical/Softball History Questionnaire

MEDICAL HISTORY

Name _____ Age _____ Date _____

Race _____ Occupation _____ Sex _____

Education (circle highest grade completed) 6, 7, 8, 9, 10, 11, 12, college - 1, 2, 3, 4, Advanced Degree

Family History:

Father: Living _____ Deceased _____ Age _____ Cause _____

Mother: Living _____ Deceased _____ Age _____ Cause _____

Heart Disease _____ Diabetes _____ Stroke _____ Cancer _____

Asthma _____ Allergies _____ Other _____

Past Health:

Childhood diseases (severe or complicated)_____

Accidents _____

Hospitalizations: Yes _____ No _____ (if yes, please explain more on back)

Current Health - please answer yes or no:

chest pain ____ breathing trouble ____ cough ____wheezing ____

short breath ____ indigestion ____ bowel trouble ____

backaches ____ urination problems ____ joint pain ____

headaches ____ blackouts ____ bleeding ____(from where _____)

vision trouble ____ Comments _____

_____

Medications - Current: Yes _____ No _____

Type _____

Exercise (within the past six months):

Very Active ____ Active ____Slightly Active ____Sedentary ____

Do you participate in a regular fitness program (2X week)
Yes ___ No ___

What kind of recreation activity? _____

In the past, were you a regular exercise participant?
Yes _____ No _____

When and why did you cease participation? Date_____

Reason for Quitting _____

_____

Softball playing experience:

Have you ever participated in varsity softball at the college or junior college level? Yes _____ No _____

Have you participated in any of the following areas of organized softball within the past three years? (please answer yes or no)

High School _____ AAU _____ ASA _____ USSSA _____

City League _____ Church League _____ Other _____

APPENDIX E

Physicians Form

March, 1988

Dear Physician:

A training program designed to determine which softball base running starting technique is most efficient at getting a runner off one base and on her way to the next will be conducted this Spring at Emporia State University. The program is designed for apparently healthy individuals. It involves a thirty minute training session for a total of nine days. During that time, individuals will be running wind sprints a distance of thirty feet with a minute and a half rest between each one. Each of the sessions will also include a warm-up and a cool-down period. Each individual will be encouraged to participate within her own capabilities.

Janet Koenig, a Graduate Student in HPERA at ESU, will be leading the program. All participants 35 years of age or older or those who have or have had any cardiovascular respiratory deseases are required to obtain medical clearance to participate in this program.

If you have any questions, please call Janet Koenig at 343-1200, ext. 5930.

Sincerely,

I believe that_____is, from a medical perspective,
(participant's name)

able to participate in the training program as described above.

_____
(Physician's Name)

_____ _____
(Date) (Physician's Signature)

APPENDIX F

Flexibility Exercises

Flexibility Exercises

Butterfly Stretch	Pull head toward toes. Ten counts repeated twice.
V-Sit Stretch	10 counts to left leg, 10 counts to center, 10 counts to right leg. Repeat sequence twice.
Spinal Twist	Each side of lower back is stretched to the count of 10. Sequence is repeated twice.
Sit and Reach Stetch	Keeping legs straight reach for toes. Ten count repeated twice.
Hurdler Stretch	Each leg is stretched to 10 counts. Sequence it repeated twice.

APPENDIX G

Starting Technique Positions and Testing Apparatus

Control Group Subject

Sprinter's Start Subject

Moving Start Starting Position

Moving Start Forward Push

Position of Experimenter to Call Leadoff Violations (Center Desk)

Dekan Performance Timer

Distance Run Between Bases

Position of Pitcher, Subject, and Timer

APPENDIX H

Training Session Teaching Procedures

Teaching Procedures

Warm-Up

Jog 2 laps around the gym
Stretches (as outlined in Appendix F)
- Butterfly
- V-Sit
- Spinal Twist
- Sit and Reach
- Hurdler Stretch

Starting Technique Training Procedures

Demonstration of Technique
- Foot placement of base
- Leaving the base
- Watching the pitcher
- Timing the release of ball and foot from base
- Runner's arm movement
- Runner's eye and head position

Cool-Down

Stretches
- Butterfly
- V-Sit
- Spinal Twist
- Sit and Reach
- Hurdler Stretch

Key Points for Moving Start Technique

Runner in motion at the time the ball is released
Lead foot is on edge of the base toward the next base and the trail foot is a step behind the base in foul territory
Left foot lead foot -- right foot trail foot
Place lead foot on outfield side of base
Weight evenly balanced but centered behind base
As pitcher begins delivery the runner's weight shifts to her trail foot
As pitcher's arm comes forward and down, runner's weight shifts over the lead foot allowing the trail foot to take a step
As pitcher releases the ball, runner lands on her trail foot
Keep body low and horizontal

Key Points for Sprinter's Start Technique

Hip and shoulders facing next base
Runner in crouched position with trail foot on lead side of base
Lead foot one step in front of base in line with next base
Toes and knees point directly toward next base
Weight forward on balls of feet, heels in upward position
Runner's head turned toward pitcher
As pitcher begins her windup - runner extends her back leg and begins to move her center of gravity
Primary forward thrust comes from lead foot
As ball is released - runner pushes off with trail foot and strides toward next base