The effect of coaching on two-handed catching: looking at developmental differences and time from initial movement to peak hand velocity in college aged females

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A Thesis

Entitled

The Effect of Coaching on Two-Handed Catching: Looking at Developmental Differences and Time from Initial Movement to Peak Hand Velocity in College Aged Females

by

Rachel K. Smith

as partial fulfillment of the requirements for the Bachelor of Science Degree with Honors in Exercise Science

Adviser:

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Director:

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Dr. Thomas Barden

The University of Toledo

April 2009
Abstract

The purpose of this study is to examine the influence of training in fast pitched softball on the developmental process used in two-handed catching in college age females. The subjects will consist of females ranging in ages from 18 to 24 who have either participated in at least three years of varsity level softball, or have no previous experience in softball. The participants will attempt to catch a ball three times as warm up and then again five times in three different locations. Subjects will be recorded with two standard digital video cameras in the frontal and sagittal plane as well as with an eight camera 3-D video system. By examining their reactions during their catches, the differences in hand velocity and acceleration while catching will be calculated and analyzed between the two groups. Differences in body movement while catching will also be recorded and studied to help define common differences between the two groups. There is little research in the field of catching, especially when comparing and contrasting trained and untrained females.
Acknowledgements

This thesis is dedicated to my mentor, Dr. Peggy Arnos, in appreciation of her consistent support of my academic endeavors. I send big thanks to Josh Baker for all of his help in the lab and teaching me about the technology used in the process.

I also express my sincerest gratitude to Dr. Thomas Barden and all of the professors of the Honors Program at the University of Toledo for their help and encouragement.
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Background, Review of the Literature, Significance

The acts of observing, learning and practicing a movement play important roles in a person’s life. Teenagers observe their parents driving for sixteen years of their lives. They then go to Drivers Education and learn how to drive. Finally, they are able to practice driving with their parents or instructor for six months. These steps play an important role in the development of a person’s ability to drive a car safely. After sufficient practice, he does not need to think about pushing in the clutch and then putting the car into gear. This becomes second nature to him. However, if these steps were to be erased from a teenager’s life, that teenager would be at risk and a hazard whenever he stepped into the driver’s seat. This pertains to all parts of life, not just to driving a car. Athletics is a field in which a subject may practice a specific motor skill, such as pitching or catching a ball, for nearly his whole adolescence. An athlete observes his sport being played in every practice. A coach instructs him on how to improve his game. He is then able to practice and receive feedback from other players and his coach. Throughout the season, the player will practice his skills and become more adapt to perfecting his skills. Although endowed talent cannot be taught, becoming skillful in motor abilities does
not happen over night (Clark 1995). However, boys who have been trained in a certain motor skill may be able to repeat this motion with more ease and quickness over time (Tayler and Davids 1997, Kelso et al. 1979). There has been a limited amount of studies in this field, in most are directly aimed at studying males. Motor skills may be quicker and more skillful in females who are experienced fast-pitched softball players than in girls who have had no training at any level.

The sport of softball has evolved since the early days. In varsity level fast-pitched softball, pitches may clock in at over 60 mph, the fields have been shortened from slow-pitched dimensions, and fielders have less time to react when fielding. How a fielder catches the speeding ball depends on how she was trained. When catching a ball, the hands have to move in such a way that it arrives at the right place at the right time (Peper 1994). If the hands are not positioned correctly, the player could miss the ball or could possibly have a greater turnover time before throwing the ball. This turnover time will be referred to as the catch-to-throw time. In addition to proper catching fundamentals, a fielder relies on bimanual coordination to complete the skilled motion. By studying professional baseball players, it is easy to see that two handed catches
are preferred in a game-like situation. Bimanual coordination is the ability to match the motion of one hand to the other when performing a task such as catching a ball.

In Peper’s Fourth Experiment on catching balls, subjects attempted to catch swinging balls that would come in close proximity of the catcher (1994). A beam with balls hung on strings was positioned over the subject’s head. The balls were raised in front of the subject so that the string was kept taut. The balls were then released, one at a time, and swung in an arc towards the subjects. The subjects wore an optoreflector which was more visible when a subject’s hand was open versus in a fist. In addition to the optoreflectors, subjects wore goggles which limited their view at certain times. During the fourth experiment, subjects were tested in nine different scenarios. The subjects caught balls in three different planes (which only the parallel plane was studied) and while only being able to see at three different times, early (500-800 ms), middle (800-1100 ms), and late (1100-1400 ms) after the ball was released. Peper found that the hands reacted more accurately when the subject had less time to react, meaning when they were able to see during the late time trials (Peper 1994). Peper did not just test how well they reacted
to differences in viewing times, but also how fast their hands closed around the ball during the different scenarios. There were no significant differences in the velocity of the hand-closing velocities between each of the three scenarios. This demonstrates that the time-to-contact was not underestimated, although the viewing time changed. Peper used both male and female subjects for his study (1994). He also did not take into consideration whether any of the subjects had been trained in baseball or softball which may give them some advantage over the other subjects and/or skew the data.

The main research in two-handed reaction times occurred in the late 1970s. Initial movements of the hands to the target start at the same time in both easy and difficult situations (Kelso et al. 1979). In this study, subjects were to hit a marker placed at various distances from the initial start point. The further away the marker, the more difficult the task. The hand reactions from the subjects were then recorded. Interestingly, the same amount of time was used for both easy and difficult trials, hinting that the acceleration and velocity of the hands responding to the difficult stimuli must be greater. From the study by Kelso et al. the theory that movement of both hands to a ball would also begin at the same time and that velocity
and acceleration would directly vary due to the height or velocity of the ball (1979). This experiment does not denote if male or female subjects were used. Kelso et al. also did not use trained subjects during this study (1979).

Much of what Tayler and Davids studied in their 1997 research is similar to Kelso et al. (1979). However, unlike Kelso et al. who studied the movement of the hands hitting buttons in a longitudinal, 2D scenario; Tayler and Davids took a look at the whole arm, specifically the hand in relation to catching a moving object (1997). They found that when a ball is caught off to the side of the main body, the two hands move at different speeds to the ball in order to arrive at the same time (1997). This helps demonstrate that the body reacts in order to catch the ball with the two hands simultaneously as well as demonstrating the use of bimanual coordination (Tayler and Davids 1997). In the same study, Tayler and Davids investigated the effects of neural cross talk when catching a ball with two hands (1997). Eleven men, all with some varsity-level ball game experience, participated in this study. They found that when catching a ball in front of the chest, the hands reacted nearly simultaneously to each other, with less than 1 ms difference. Even when reacting to a ball being caught over the right and left shoulders the data suggest that
there was no significant difference in acceleration between the limbs, with the largest acceleration difference being 6ms. Tayler et al. also tracked Movement Initiation Time (MIT) data which showed that both limbs initiated movement together in all directions (1997). This shows that even when one limb has further to travel than the other, they start at the same time, give or take a few milliseconds.

Having a great reaction time and quick body movement aid in the successfulness of a catch. Predictive information regarding where the ball may land may also be used in order to align the catcher’s full body. Experienced fielders do not only run to where they hypothesize the trajectory of the ball going but a little further so that they are able to stop, turn around and charge the ball in order to speed up the throw to the infield (McBeath 1995). Through coaching each of the spatial-temporal coordination steps of catching a ball are practiced until they become second nature, just like driving a car. Varsity softball players practice every day so that they are able to call on these specific motor skills in a moment’s notice in order to compete at an elite level.

There are four proposed developmental sequences for catching in childhood and adolescence: Preparation (hand component), Reception (arm component), Hand Component, and
Body Component (Roberton and Halverson 1984). Each sequence is broken down into three to four sub-steps. During preparation, beginners await the tossed ball with their arms outstretched and with their elbows extended. Intermediates tend to wait with some shoulder flexion, but flexion now appears in the elbow. Experienced catchers prepare for the ball catch with the arms in a relaxed posture at the sides of the body or slightly ahead of the body.

During the reception stage, Roberton and Halverson noticed that beginners keep their arms outstretched with their elbows rigid (1984). The subjects do not react to receive the ball, so it bounces out of their reach. In the second step, palms are face up and elbows slightly bent. The ball is then trapped against the body. The third step involves the subject catching with their hands, but may still use their body to trap. Experienced ball catchers complete the catch by catching the ball with their hands in a downward motion instead of an upward, trapping motion.

The Hand Component is broken down into relatively simple steps. In the beginning, catchers’ palms are usually faced upwards. Intermediates keep their palms facing each other while the palms of experts adjust to the flight path of the object.
Finally, the Body Component reflects the most basic changes. Beginners make no body adjustment to the flight of the ball while intermediates move their arms and trunk in relation to the ball’s flight path. The experts move their feet, trunk, and arms in anticipation of the oncoming ball.

There is a fifth stage which incorporates all of the expert stages of the previous components, but includes a “feet component.” A majority of catches in a game-like environment have one end goal: catching and throwing of the ball as fast as possible. The time that it takes to catch a ball and throw it again is called the catch-to-throw speed. In addition to moving their trunks, arms and hands at the highest level, people who reach the fifth stage will position themselves behind the anticipated ball catching location and step up to and through the ball. This allows the catcher to put her body into a crucial position which will accelerate her catch-to-throw speed (Roberton and Halverson 1984).
Objectives/Specific Aims

Within my research, I hope to follow the role of coaching in college-aged females by studying hand velocity, acceleration, and mechanics (full body) of females who have participated in at least three years of high school varsity level softball and of females who have never participated in any level of softball. I plan on collecting hand speed and acceleration similar to Peper’s research, but by using the Cortex program, which is a current technology, allows me to analyze 3-D figures of the subject on a computer (1994). Also, instead of swinging balls, I will use a trained thrower to better represent the flight of a batted ball when playing softball. I hypothesize that Group A (Expert, Varsity-Level) will have significant quicker hand velocities and hand acceleration over Group B (No Training).

Finally, Roberton and Halverson studied the different developmental sequences for catching (1984). They did not denote the specific age or gender of their subjects, however their drawn pictures depict male children performing the catches. Throughout the years, sports have been dominated by males. In our society, far fewer young females are encouraged to enter sports in comparison to their male counterparts. There is scant literature
researching the differences between female athletes and female non-athletes. I hypothesize that from this study, we will find that a significant number of girls from Group A will be at a higher motor developmental level than Group B based on the developmental sequences of Roberton and Halverson (1984). However, I also hypothesize that there will not be much significant difference based on Roberton and Halverson’s sequences. With this study, I hope to be able to better qualify what represents traits of a trained female versus mechanics of a non trained female.
Methodology/ Approach

a) Study Design

This is a cross-sectional study. Subjects will report to the UT Biomechanics laboratory for collection of demographic data and familiarization with procedures and equipment. The subject’s name, age, the number of years in an organized, fast pitch softball league, the number of years playing at the varsity level, and their most common position will be recorded. The informed consent will be presented to them at this time. The subject will warm up for five minutes on a stationary bicycle and then be allowed three to five minutes to stretch. The co-investigator will verbally explain the process of the experiment. Reflective globes will be placed at the joining of their carpal bones with the ulna and radius, at the lateral epicondyles of the humerus, and at the acromioclavicular joint. One marker will be placed on the right scapula for identity. Reflective tape will be placed on the softball so that the movement of the ball can also be recorded.

In attempt to minimize the number of variables and risks, all subjects will use their bare hands to catch the softballs. The subject will then catch three practice throws in three different locations. The first set of
catches will be aimed directly to the subject, the second set will be a few steps in front of the subject, and the final set will be a few steps behind the subject.

The subject will then undergo five more successful catches in each direction which will be recorded and analyzed. If the subject needs to reach laterally more than two feet, a reflective marker falls off the body, or there is a major subject error (such as tripping), that trial will be considered a mistrial and will not be included in the final data. If the subject fails to catch a ball under normal circumstances, the trial will be considered a failed attempt and denoted with an asterisks (*), but will still be analyzed for results. The entire process will be videoed from the frontal plane and the sagittal plane with normal digital video cameras as well as an eight camera, 3-D Video system that will capture the kinematic and kinetic events during catching. Arm positioning, velocity and acceleration will be recorded for each trial (Figure 1). In addition, the positions of the trunk, feet, shoulders, hands, and head will be noted for each trial so that the differences in the biomechanics of the catch can be analyzed between trained and non-trained subjects.

A scale was created based on Roberton and Halverson’s findings when studying the development of catching skills
in children and adolescents (Table 1). What Roberton and Halverson found to be a “beginner” movement, was denoted with 1 point on the scale used for this study. “Intermediate” movements were awarded 2 points and “Expert” movements were awarded with 3 points. A minimum of 8 points and a maximum of 24 points could be given to an individual depending on their skill level.

Table 1: Breakdown of components

<table>
<thead>
<tr>
<th>Component</th>
<th>Beginner</th>
<th>Intermediate</th>
<th>Experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm</td>
<td>1. Arms outstretched</td>
<td>2. Some shoulder flexion</td>
<td>3. Arms relaxed</td>
</tr>
<tr>
<td>Elbow</td>
<td>1. Elbows extended</td>
<td>3. Flexion at elbows</td>
<td></td>
</tr>
<tr>
<td>Reception</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Elbows ridged</td>
<td>2. Elbows greatly bent</td>
<td>3. Elbows slightly bent</td>
</tr>
<tr>
<td></td>
<td>1. Do not react to ball, thus fail to catch</td>
<td>2. Trapping motion</td>
<td>3. Receiving motion</td>
</tr>
<tr>
<td>Hand</td>
<td>1. Palms up</td>
<td>2. Palms facing each other</td>
<td>3. Palms adjusted to flight path</td>
</tr>
<tr>
<td>Body</td>
<td>1. No body adjustment</td>
<td>2. Arms and trunk move in relation to flight path</td>
<td>3. Move feet, trunk, and arms to flight path</td>
</tr>
<tr>
<td>Feet</td>
<td>1. No feet movement</td>
<td>2. One step movement</td>
<td>3. Step up and through ball</td>
</tr>
</tbody>
</table>
b) Method of treatment assignment

This is an open-label study where subjects will be placed in Group A if they have had participated in at least three years of high school varsity level softball or in Group B if they have no previous experience with softball.

c) Inclusion/exclusion criteria

Inclusion criteria: females between the ages of 18-24, healthy, participated in organized fast-pitched, high school varsity level softball for a minimum of 3 years or have no previous history of softball training, right hand dominance when throwing.

Exclusion: previous history of upper extremity surgery, any upper extremity fracture or injury that still affects normal ROM or is painful to the subject, pregnant, any neurological or cardiorespiratory disorder with the exception of mild to moderate asthma.

d) Justification of the number of subjects

A significant difference, if available, should be able to be seen with sixteen subjects. Most prior research in this field had a maximum of twenty subjects, many having less than fifteen.
e) Study setting

The study will be conducted in the Biomechanics Laboratory at the University of Toledo where eight 3-D cameras are built into the design of the room.

f) Primary and secondary outcome measures

Primary: Collect and calculate the greatest velocity and acceleration of the hands during the upward motion to catch a moving ball. The trial that does not involve moving will be used to calculate the velocity and acceleration.

Secondary: Study the differences in biomechanical sequencing between Group A and Group B.

g) Variables

The main variable being studied is whether the subject is trained or untrained. Demographic, race, and medical conditions could all be possible variables, however they should not be significant to this study.

h) Procedures, interventions, schedule

The study design section above explains the involvement of the subject. The informed consent and stretching will take approximately eight minutes. Putting reflective markers on the subject will take approximately five minutes. Practice trials do not need to be recorded except to make sure the equipment is functioning properly and should take about ten minutes. The experiment trials
should be able to be completed in thirty minutes, leaving about fifteen minutes to work out any complications or to answer any questions the subject may have.

i) Planned data analysis

Simple calculations to find subjects’ hand velocity and acceleration will be used. A paired t-test will be used to compare the results of Group A (Softball Players) and Group B (Non Softball Players). The developmental differences presented by Roberton and Halverson will be used as a guide to help reveal differences between Group A and Group B when catching a softball.
Results

When catching the softball tossed directly to the receiver, softball players averaged a peak velocity of 2016.772 mm/sec with their right hand and 2042.38 mm/sec with their left hand. Softball players averaged a peak acceleration of 14755.15 mm/sec$^2$ with their right hand and 14892.09 mm/sec$^2$ with their left hand. There is a difference of 25.608 mm/sec between their left and right hand velocities and 136.94 mm/sec$^2$ between their left and right hand accelerations.

Non softball players averaged a peak velocity of 1947.495 mm/sec with their right hand and 1946.408 mm/sec with their left hand. They averaged a peak acceleration of 14434.8 mm/sec$^2$ with their right hand and 15094.04 mm/sec$^2$ with their left hand. There is a difference of 1.087 mm/sec between their left and right hand velocities and 660.14 mm/sec$^2$ between their left and right hand accelerations.

There is a visual difference between the two group’s average peak velocity, however Table 2 shows that the difference is not significant (Right Hand, $P = .542$; Left Hand, $P = .393$). There is also a visual difference between the two group’s average peak acceleration of their right hand, however there is no significant difference ($P = .726$). There is not a great difference visually nor
statistically between the average peak acceleration of the left hand (P = .847).

When looking at the differences in time to reach peak velocity between the left and right hands, there is a significant difference between the softball players and the non softball players (P = .016). Additional statistical data can be found from Tables 3, 4, 5, and 6 located in the index section.

<table>
<thead>
<tr>
<th>Table 2. Table of Means</th>
<th>Softball</th>
<th>Non Softball</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference in Time to Peak</td>
<td>-0.0422</td>
<td>-0.0027</td>
<td>0.016</td>
</tr>
<tr>
<td>Average Peak Velocity Left Hand</td>
<td>2042.3804</td>
<td>1946.4079</td>
<td>0.393</td>
</tr>
<tr>
<td>Average Peak Velocity Right Hand</td>
<td>2016.7725</td>
<td>1947.4953</td>
<td>0.542</td>
</tr>
<tr>
<td>Average Peak Acceleration Left Hand</td>
<td>14892.085</td>
<td>15094.935</td>
<td>0.847</td>
</tr>
<tr>
<td>Average Peak Acceleration Right Hand</td>
<td>14755.148</td>
<td>14434.795</td>
<td>0.726</td>
</tr>
<tr>
<td>Catching Proficiency Scale “Ball tossed to player”</td>
<td>21.825</td>
<td>17.05</td>
<td>0.000201</td>
</tr>
<tr>
<td>Catching Proficiency Scale “In front of player”</td>
<td>22</td>
<td>18.925</td>
<td>0.00015</td>
</tr>
<tr>
<td>Catching Proficiency Scale “Behind player”</td>
<td>22.225</td>
<td>18.85</td>
<td>0.0018</td>
</tr>
</tbody>
</table>

The final aspect that was studied during this study was the analysis of the developmental components used when catching (Table 1). Tables 7, 8, and 9 in the index show the breakdown of the statistical data derived from this section using a Paired Two Sample t-test. This is a fairly
subjective test, however when the data are compiled, the differences are significant in each of the three scenarios (P = .000201, P = .00015, P = .00183). Softball players averaged 21.825 points based on Roberton and Halverson’s scale of development in catching while non softball players averaged 17.05 points when catching a ball tossed directly to the person. When the ball was tossed in front of each group, softball players averaged 22 points and non softball players averaged 18.925 points. Finally, when the ball was tossed behind the subjects, softball players averaged 22.226 points and non softball players averaged 18.85 points.
Discussion

Average peak velocities and average peak accelerations of the hands between softball players and non softball players were not statistically significant. However, there is a visual trend that softball players had higher peak velocities in both their right and left hands and higher peak acceleration in their right hands. Non softball players had a huge increase in the acceleration of their left hand over their right hand. This could be due to the fact that non softball players are not as ambidextrous as softball players and tended to overcompensate for their left hand by trying to move it with a greater acceleration to reach the ball.

Softball players may have higher peak hand velocities in both wrists due to the fact that they may wait longer to react to the ball and therefore need to move quicker to catch the ball. This could also be due to the biomechanics that a softball player goes through to catch a ball. More proficient catchers will follow the ball’s descent starting with their elbows extended and flexing their elbows and descending their hands until finally catching the ball at shoulder height. In order to set up for this type of a catch, the softball players must get their hands into the
air quicker than intermediate catchers who might catch the ball while their hands are ascending.

Time from initial movement to peak velocities also varied from softball players to non softball players. In most trials performed by softball players (n = 33), their left hand reached peak velocity quicker than their right hand. In only a few trials (n = 7), did their right hand reach the peak velocity before their left hand (Graph 3). On the contrary, non softball players did not seem to favor either their right hand or left hand when testing for peak velocity from initial movement. An even number of trials (n = 20) were recorded for non softball players reaching the peak velocity with their right hand as with their left hand (Graph 4). This helps supports the notion that unlike softball players, non softball players do not actively show a preference to their dominant or non dominant side when catching the ball. For a majority of the trials, non softball players caught the ball in the middle of their body, making their arms travel the same distance. Softball players caught the ball on their right side, dominant throwing arm, thus making their left hand move a further distance, possibly have a slightly greater acceleration, and allowing for a greater time difference from initial movement to peak velocity than the dominant, right hand.
The average number of points earned based on Roberton and Halverson’s scale of development between softball players and non softball players varied by 4.775 points (tossed to subject), 3.075 points (tossed in front), and 3.376 points (tossed behind). When looking at the trials when the ball was tossed directly to the subjects, non softball players would fall into the “intermediate” category (Figure 1), while softball players would fall into the “experienced” category (Figure 2). However, in both of the other two trial series, the average point totals put both groups into the “experienced” category. There are obvious differences in the styles of catching and these differences are significant as stated before, even if the numbers categorize them in the same stage. Roberton and Halverson’s study was based on the developmental aspects of children and when they reached each level. With this in mind, it would seem that all healthy young adults would have achieved the experienced stage, or at least the intermediate stage, in their youth. So, although this information is significant, more differences between the two groups can still be gathered. While watching the two groups, there were distinct characteristics of the softball players’ catch that were missing in the non softball players’ catch. Testing to see how prevalent these
differences are in softball players would be a quick study. By using the same set up that was used in this study, an investigator could make a flow chart similar to Table 1 including these observations. These differences include:

* Catching the ball on her dominant side
* Catching the ball at shoulder level
* Move both feet when ball goes out of a certain distance from the body. This distance is dependant on each girl
* Prepare for catch and catch with knees flexed
* When catching ball tossed behind the subject, lower body initiates movement
* Catch with palms following the path of the ball whenever possible
* Do not catch while flexing at the hips, move to catch ball

These differences could be due to a coach or coach-like figure teaching proper catching techniques. In addition, girls who play sports might be more likely to watch sporting events, therefore the softball players might watch baseball or softball on television and become familiar with some of the techniques that might not be noticed by non softball players. Regardless of how the differences occurred there is a significant difference between softball players and non softball players which is seen both visually and statistically. Roberton and Halverson could have additionally broken down their older subjects into two groups who 1) have played ball sports and 2) have not played ball sports, to better represent their data.
Comparison of older children based on their gender may show the differences that were found in this study.
Conclusion

Although the two groups both consisted of college aged females, almost everything about their way of catching a ball was significantly different. Only average peak velocity and acceleration of the wrists were not significantly different between softball players and non softball players.

There is a significant difference within the two groups in the time from initial reaction to peak velocity between the right and left hands.

Finally, there is a significant difference in how each group catches the ball. From a scale based on Robertson and Halverson’s research, softball players averaged from 3 to 4 points higher than non softball players in each of the three trials (ball tossed to, in front, and behind). These findings are significant.

Softball players do experience significant differences between their catching abilities and non softball players’ catching abilities. With further research in catching, knowledge of this field could be expanded and applied to a sports concentration or to daily life. The importance of female sports has been evident over the past few decades, and this study is one more indication of how differences
are unmistakable between females who play varsity level sports and those who do not.
Works Cited


<table>
<thead>
<tr>
<th></th>
<th>Softball</th>
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<tr>
<td>Difference in Time to Peak</td>
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<td>-0.0027</td>
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<td>14434.795</td>
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<td>1. Arms outstretched</td>
<td>2. Some shoulder flexion</td>
<td>3. Arms relaxed</td>
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<td>3. Flexion at elbows</td>
<td>3. Flexion at elbows</td>
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<td>2. Arm moving upwards</td>
<td>3. Arms moving downwards</td>
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<td><strong>Arm Component</strong></td>
<td>1. Elbows ridged</td>
<td>2. Elbows greatly bent</td>
<td>3. Elbows slightly bent</td>
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<td></td>
<td>1. Do not react to ball, thus fail to catch</td>
<td>2. Trapping motion</td>
<td>3. Receiving motion</td>
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<td><strong>Hand Component</strong></td>
<td>1. Palms up</td>
<td>2. Palms facing each other</td>
<td>3. Palms adjusted to flight path</td>
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<tr>
<td></td>
<td>1. No body adjustment</td>
<td>2. Arms and trunk in relation to flight path</td>
<td>3. Move feet, trunk, and arms to flight path</td>
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<td>1. No feet movement</td>
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Table 3: Peak Velocity of Right Hand Between Softball Players and Non Softball Players

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<td>t Stat</td>
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<td>t Critical one-tail</td>
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Table 4: Peak Acceleration of Right Hand Between Softball Players and Non Softball Players

\[ t \text{-Test: Paired Two Sample for Means} \]

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<td>Df</td>
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Table 5: Peak Velocity of Left Hand Between Softball Players and Non Softball Players

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### Table 6: Peak Acceleration of Left Hand Between Softball Players and Non Softball Players

**t-Test: Paired Two Sample for Means**

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Table 7.
Body Movement when ball tossed directly to person

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<td>t Stat</td>
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<td>P(T&lt;=t) one-tail</td>
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<td>t Critical one-tail</td>
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Table 8.
Body Movement when ball tossed in front of person
$t$-Test: Paired Two Sample for Means

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Table 9.
Body Movement when ball tossed behind the person

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<td><strong>Variable 1</strong></td>
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<tr>
<td>Variance</td>
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<tr>
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<td>t Stat</td>
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<tr>
<td>t Critical one-tail</td>
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<tr>
<td>P(T&lt;=t) two-tail</td>
</tr>
<tr>
<td>t Critical two-tail</td>
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Graph 1: Average Peak Velocity of the Wrist

Average Peak Velocity of the Wrist

mm/sec

1880 1900 1920 1940 1960 1980 2000 2020 2040 2060

Left Right

Non Softball Players Softball Players
Graph 2: Average Peak Acceleration of the Wrist

Average Peak Acceleration of the Wrist

mm/sec²

- Non Softball Players
- Softball Players

Left

Right
Graph 3: Softball Players: Difference in Time to Peak from Left to Right Hand

Softball Players: Difference in Time to Peak from Left to Right Hand

-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
Seconds from initial movement to Peak Velocity

Trial

Left Hand Faster than Right Hand
Right Hand Faster than Left Hand
Graph 4: Non Softball Players: Differences in Time to Peak from Left to Right Hand

Non Softball Players: Differences in Time to Peak from Left to Right Hand

Seconds from initial movement to Peak Velocity

Trial

-0.2 -0.15 -0.1 -0.05 0 0.05 0.1 0.15 0.2

Right Hand Faster than Left Hand

Left Hand Faster Than Right Hand
Figure 1: Floor Space

○ = 3-D Video Camera
△ = Digital Camera
□ = Ball Thrower
★ = Location of Ball Catcher
(Subject)
Figure 2: Intermediate Catching
Figure 3: Experienced Catching
Figure 4: Intermediate vs. Non Softball Player
Figure 5: Non Softball Player’s 3D Arms
Figure 6: Experienced vs. Softball Player
Figure 7: Softball Player’s 3D Arms
INSTRUCTIONS:

All UT research using living human subjects, or samples or data, obtained from them, directly or indirectly, with or without their consent, must either be approved in advance by the UT Institutional Review Board (IRB), or be found to meet narrow criteria for exemption from IRB oversight by the IRB office. This Form will help the PI to determine if the project is likely to meet the criteria for expedited review and to document the decision on this request.

Expedited review procedures are described in 45 CFR 46.110. In short, the IRB Chair or one or more experienced reviewers, designated by the Chair from among members of the IRB, review the research and approve it or refer it to the convened IRB for full IRB discussion.

For a new research project to qualify for expedited review, the following must apply:

(A) Research activities that (1) present no more than minimal risk to human subjects*, and (2) involve only procedures listed in one or more of the following categories, may be reviewed by the IRB through the expedited review procedure authorized by 45 CFR 46.110 and 21 CFR 56.110. The activities listed should not be deemed to be of minimal risk simply because they are included on this list. Inclusion on this list merely means that the activity is eligible for review through the expedited review procedure when the specific circumstances of the proposed research involve no more than minimal risk to human subjects.

(B) The categories in this list apply regardless of the age of subjects, except as noted.

(C) The expedited review procedure may not be used where identification of the subjects and/or their responses would reasonably place them at risk of criminal or civil liability or be damaging to the subject’s financial standing, employability, insurability, reputation, or be stigmatizing, unless reasonable and appropriate protections will be implemented so that risks related to invasion of privacy and breach of confidentiality are no greater than minimal.

(D) The expedited review procedure may not be used for classified research involving human subjects.

(E) The standard requirements for informed consent (or its waiver, alteration, or exception) apply regardless of the type of review--expedited or convened--utilized by the IRB.

(F) Categories one (1) through seven (7) pertain to both initial and continuing IRB review.

*Minimal Risk is defined as “the risk of harm anticipated in the proposed research that is not greater, considering the probability and magnitude, than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.”
If after reading the instructions and expedited categories your human subject research protocol appears to meet the requirements for expedited review, please follow these instructions:

2. Attach page 2 and 3 to your application with the appropriate category or categories checked.
3. Complete the checklist provided on page 12 to ensure a complete application has been submitted.

**EXPEDITED CATEGORIES** *(According to OPRR Reports, Title 45, CFR 46, rev. June 18, 1991)*

Please identify all that apply to your research (check applicable boxes)

<table>
<thead>
<tr>
<th></th>
<th>Clinical studies of drugs and medical devices only when condition (a) or (b) is met.</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Research on drugs for which an investigational new drug application (21 CFR Part 312) is not required. (Note: Research on marketed drugs that significantly increases the risks or decreases the acceptability of the risks associated with the use of the product is not eligible for expedited review.)</td>
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<tr>
<td></td>
<td>Research on medical devices for which (i) an investigational device exemption application (21 CFR Part 812) is not required; or (ii) the medical device is cleared/approved for marketing and the medical device is being used in accordance with its cleared/approved labeling.</td>
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<td>2</td>
<td>Collection of blood samples by finger stick, heel stick, ear stick, or venipuncture as follows:</td>
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<td>from healthy, nonpregnant adults who weigh at least 110 pounds. For these subjects, the amounts drawn may not exceed 550 ml in an 8 week period and collection may not occur more frequently than 2 times per week; or</td>
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<td></td>
<td>from other adults and children, considering the age, weight, and health of the subjects, the collection procedure, the amount of blood to be collected, and the frequency with which it will be collected. For these subjects, the amount drawn may not exceed the lesser of 50 ml or 3 ml per kg in an 8 week period and collection may not occur more frequently than 2 times per week.</td>
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<td>3</td>
<td>Prospective collection of biological specimens for research purposes by noninvasive means.</td>
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<tr>
<td></td>
<td>Examples:</td>
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<tr>
<td></td>
<td>a. hair and nail clippings in a nondisfiguring manner;</td>
</tr>
<tr>
<td></td>
<td>b. deciduous teeth at time of exfoliation or if routine patient care indicates a need for extraction;</td>
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<tr>
<td></td>
<td>c. permanent teeth if routine patient care indicates a need for extraction;</td>
</tr>
<tr>
<td></td>
<td>d. excreta and external secretions (including sweat);</td>
</tr>
<tr>
<td></td>
<td>e. uncanulated saliva collected either in an unstimulated fashion or stimulated by chewing gumbase or wax or by applying a dilute citric solution to the tongue;</td>
</tr>
<tr>
<td></td>
<td>f. placenta removed at delivery;</td>
</tr>
<tr>
<td></td>
<td>g. amniotic fluid obtained at the time of rupture of the membrane prior to or during labor;</td>
</tr>
<tr>
<td></td>
<td>h. supra- and subgingival dental plaque and calculus, provided the collection procedure is not more invasive than routine prophylactic scaling of the teeth and the process is accomplished in accordance with accepted prophylactic techniques;</td>
</tr>
<tr>
<td></td>
<td>i. mucosal and skin cells collected by buccal scraping or swab, skin swab, or mouth washings;</td>
</tr>
<tr>
<td></td>
<td>j. sputum collected after saline mist nebulization.</td>
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</table>
4. Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications.)

**Examples:**

a. physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the subject or an invasion of the subject’s privacy;
b. weighing or testing sensory acuity;
c. magnetic resonance imaging;
d. electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, Doppler blood flow, and echocardiography;
e. moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual.

5. Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis). (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects, 45 CFR 46.101(b)(4). This listing refers only to research that is not exempt.

6. Collection of data from voice, video, digital, or image recordings made for research purposes.

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

8. Continuing review of research previously approved by the convened IRB as follows:

a. where (i) the research is permanently closed to the enrollment of new subjects; (ii) all subjects have completed all research-related interventions; and (iii) the research remains active only for long-term follow-up of subjects; or
b. where no subjects have been enrolled and no additional risks have been identified; or

c. where the remaining research activities are limited to data analysis.

9. Continuing review of research, not conducted under an investigational new drug application or investigational device exemption where categories two (2) through eight (8) do not apply but the IRB has determined and documented at a convened meeting that the research involves no greater than minimal risk and no additional risks have been identified.
A. STUDY INFORMATION

<table>
<thead>
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<th>12-18-08</th>
<th>IRB Number: (Assigned by IRB office)</th>
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<td>Study Title:</td>
<td>The Effect of Coaching on Two-Handed Catching Instincts and Developmental Differences in College Aged Females</td>
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<tr>
<td>Principal Investigator or Faculty Advisor:</td>
<td>Dr. Peggy Arnos</td>
<td>S. S. # or UT Rocket #</td>
</tr>
<tr>
<td>Department:</td>
<td>Department of Kinesiology</td>
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</tr>
<tr>
<td>Contact Person: (If applicable)</td>
<td>Rachel K. Smith</td>
<td></td>
</tr>
<tr>
<td>Contact Person’s Role on Project:</td>
<td>Co-Investigator</td>
<td></td>
</tr>
<tr>
<td>Contact Person’s Phone:</td>
<td>614-271-1467</td>
<td></td>
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<tr>
<td>Contact Person’s Fax:</td>
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<td></td>
</tr>
<tr>
<td>Is this a student project?</td>
<td>☒ Yes ☐ No</td>
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</table>

B. STUDY PERSONNEL

Please list all study personnel involved in the conduct of this study. All study personnel must complete required training in human subject research and provide to the IRB office certification verifying completion of the requirement.

The IRB will not review a study without such forms on file for all research personnel. Only UT faculty, staff, students, or registered volunteers are considered “UT-affiliated” and thus covered by the UT IRB review. All non-affiliated study personnel must have their participation reviewed by their institution’s IRB, or complete an Individual Investigator Agreement with The University of Toledo.

<table>
<thead>
<tr>
<th>Name</th>
<th>UT Affiliated</th>
<th>S.S. # or UT I.D. #</th>
<th>Role in Protocol</th>
<th>**Role in Consent Process</th>
<th>Training Completed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Peggy Arnos</td>
<td>☒</td>
<td></td>
<td>*Principal Investigator</td>
<td>Explain informed consent</td>
<td>☒ Yes ☐ No</td>
</tr>
<tr>
<td>Rachel K. Smith</td>
<td>☒</td>
<td>R000183138</td>
<td>Co-Investigator</td>
<td>Explain and obtain informed consent</td>
<td>☒ Yes ☐ No</td>
</tr>
</tbody>
</table>
### C. STUDY FUNDING

<table>
<thead>
<tr>
<th></th>
<th>☑️ Unfunded</th>
<th>☐ Funded</th>
<th>☐ Intramural</th>
<th>☐ *Extramural</th>
</tr>
</thead>
</table>

If Intramural, please provide UT Institutional Account number here: ____________________________________________

Amount: $ ☐ Per subject ☐ Total

If Extramural, please provide the following information:

<table>
<thead>
<tr>
<th>Agency/Company Name:</th>
<th>Agency ID No./Protocol #:</th>
</tr>
</thead>
</table>

Agency/Company Address:

Agency/Company Contact:

Agency/Company Contact Phone: E-Mail:

Extramural Funding Status: ☐ Pending ☐ Funded ☐ Planned

Contract Status: ☐ Pending ☐ Finalized (If final, send contract copy with the application)

Grant or Company Protocol Title:
(If different than study title)

*GRANT PROPOSAL - If the research protocol is currently supported by a grant proposal, OR if support for the research protocol has been requested under a grant proposal, attach the research proposal/protocol that was sent to the agency, committee or sponsor.

### D. PERFORMANCE SITE(S)

List all performance sites for this study. Attach permission letters and/or current IRB approval memos for off-campus sites. **Check box if site is “engaged in research.”** A site becomes "engaged" in human subjects research when its employees or agents: (i) intervene or interact with living individuals for research purposes; or (ii) obtain individually identifiable private information for research purposes [45 CFR 46.102(d),(f)]. **(Do not list non-UT sites in industry-sponsored multi-center studies.)**

<table>
<thead>
<tr>
<th>Performance site Name</th>
<th>Address</th>
<th>Engaged in research Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>The University of Toledo Biomechanics Lab</td>
<td>College of Health and Human Service Department of Kinesiology 2801 W. Bancroft St. Toledo, OH 43606</td>
<td>☑️</td>
<td>☐</td>
</tr>
</tbody>
</table>
E. STUDY SUMMARY

1. What is the objective of the study?
The aim of this study is to examine the influence of organized sports, fast pitched softball, and coaching on the development of primary instincts used in two-handed catching in young female adults. The information will be used to study the effects of coaching on hand velocity and acceleration as well as the level of catching development between two groups of girls, one group who have received coaching in fast pitched softball at a varsity level for at least three years and one group who have had no experience at any level in softball.

2. Provide a brief background and significance of the proposed research.
This research will test the impact of high school sports experience and the difference between girls who have participated in fast pitched softball and those who have not. There has been some research in the field of catching using male subjects, but the number of studies that directly study college aged females who have either competed in fast pitched softball for numerous years at a varsity level or who have had no prior coaching at any level is very limited. The information will be used to study the effects of coaching provided to females’ catching instincts, which may be important to understand the significance that coaching at a varsity level may have on a young woman’s initial hand reaction velocity, acceleration speed of the hands, and the developmental difference between two completely different groups of females.

3. Describe of the Procedures and information to be collected.
Subjects will report to the UT biomechanics laboratory where the informed consent will be presented to them. They will read and sign the informed consent. The subject’s name, age, the number of years in an organized sport, and the number of years in an organized, fast pitch softball league will be recorded. The subject will be allowed three to five minutes to stretch. The co-investigator will verbally explain the process of the experiment. Subjects will then be prepped with surface retro reflective markers. The subject will then catch three practice throws in three different planes. The first set of catches will be aimed directly to the subject, the second set will be a few steps in front of the subject, and the final set will be a few steps behind the subject. The entire warm up will be videoed from the frontal plain and the sagittal plain. In addition to video collection, initial arm velocities and accelerations will be collected from eight, 3-D cameras. The 3-D cameras will also pinpoint exact locations of different body segments. The subject will then undergo five more successful catches in each direction. These trials will also be recorded in the same manner as the practices.

4. Describe any risks involved to the subject.
During any athletic activity/maneuver an individual assumes a risk of a possible muscular/ligamentous sprain or strain. The subject may also fail to catch the ball, possibly resulting in a minor contusion. The risk is no greater than one may encounter in a normal athletic practice or workout.

5. Describe how risks will be minimized.
Explanation of the three ball toss locations will be described to the subject. The subjects will be required to perform self stretches for three to five minutes to reduce the risk of muscular strain. Risks of contusions are minimized by using a tennis ball.

6. For use of medical records:  
Will you have ongoing contact with the subjects? No  
Will you be recording identifiers? Yes  
What is the timeframe of charts that you plan to review (for example, 2/1/1999 – 2/1/2001) ? No Charts

PLEASE NOTE: Retrospective chart review can only occur on charts that were in place BEFORE you received IRB approval. Any chart information that comes into existence AFTER IRB approval is granted would be considered Prospective.
7. In addition to the attached research protocol, provide a 1-2 sentence description of the proposed research. (All research approved by expedited review must be reported to the convened IRB. This description will be reported on the IRB agenda.)

This research is an exploration of the differences in initial arm velocity and acceleration as well as body position between females receiving at least three years of high school varsity-level fast-pitch softball coaching to females who have received no fast-pitched softball coaching during their life.

F. HUMAN RESEARCH SUBJECTS

Subject Population:

Anticipated maximum number to be enrolled at this institution: 20

If multi-site, total number of subjects for entire project:

What is the gender of the subjects? [ ] Male [x] Female [ ] Both

What is the age range of the subjects 18-22

1. To what health/disease category will the human subjects belong?

All subjects will be healthy individuals with reported unremarkable past medical history for musculoskeletal disease, cardiorespiratory disease, nervous system disorders, and/or upper or lower extremity surgeries and fractures.

2. What will be the total duration of involvement of each subject in the study?

Subjects will participate in a maximum of two hours of data collection. Subjects will report to the Biomechanics Laboratory once for testing and a possible maximum of three times if there is instrumentation failure.

3. Is the research limited to any particular age, gender, ethnic, or racial group? (If an equitable recruitment from among all populations is not anticipated, please provide justification. If research is not limited to any particular group, be sure to check the appropriate boxes in #4 if any of the listed vulnerable populations may possibly be included in the study population.)

The current study will impose of females between the ages of 18-22. There has been substantially more research involving males who have participated in baseball. Females are often underrepresented to their male counterparts. It is not plausible to relate findings from male dominated studies to females due to the differences in body shape, health differences, and parental/coaching upbringings. The age group is of particular interest to the primary researchers because this is the age range of most athletes after three years of high school level coaching.

4. Will any of the following vulnerable populations be included?

☐ Minors ☐ Minority [ ] Fetuses ☐ Pregnant women

☐ Prisoners ☐ Elderly [ ] Terminally ill ☐ non-English speaking

☐ Mentally Incapacitated [ ] Cognitively Impaired ☐ Severe Psychological Disorders ☐ UT’s students or staff

5. What safeguards are in place to protect vulnerable populations involved with the proposed research?

UT students will be involved only on a voluntary basis and will be able to abort the study at any time if they wish.

6. Outline the criteria for selection and exclusion of subjects.
Inclusion criteria: females between the ages of 18-22, healthy, participated in organized fast-pitched, high school varsity level softball for a minimum of 6 seasons or have no previous history of softball training. Exclusion: previous history of upper or lower extremity surgery or fracture, pregnant, any neurological or cardiorespiratory disorder with the exception of mild to moderate asthma.

7. Will subjects receive compensation for their participation, monetary or otherwise? Yes ☐ No ☒
   If yes, specify.

8. What financial obligations will subjects incur as a result of participating in the research study? Identify expenses such as travel costs, drugs, devices, lab tests, etc. Be as specific as possible. (Itemize the procedures not covered by research funds and approximate their cumulative cost.)
   Subjects will incur the cost of traveling expenses to The University of Toledo = $20 (varies)
   There are no other financial obligations expected for this research.

G. RECRUITMENT PROCEDURES

1. What method(s) will be used to identify and recruit prospective subjects? Specify the source of potential subjects.
   Flyers will be hung around the Health Science and Human Service building on UT’s campus. In addition, this flyer will be attached to weekly, bulk email systems, UT Daily/UT News and Honors E-news.

2. Check all types of recruitment material that will be utilized in the study. Attach copies of this material to the application.

   ☒ Advertisements  ☒ Newsletters  ☒ Internet
   ☐ Brochures  ☐ Radio  ☐ Contact letters to patients or physician
   ☒ Flyers/posters  ☒ Other (Describe) (class room announcements)

3. Will you access stored medical records, data, or specimens for research use? If yes, specify the source.
   No

H-1. INFORMED CONSENT

Per Federal regulations, (45 CFR 46.117), informed consent shall be documented by the use of a written consent form approved by the IRB and signed by the subject or the subject's legally authorized representative. A copy shall be given to the person signing the form.

Refer to RSP/IRB General Instructions for Researchers Writing Informed Consent Forms for the required elements and format of informed consent forms. Under certain circumstances, the IRB may alter or waive the consent requirement.

If you are requesting an alteration or Waiver of the Consent requirement, please go to Section H-2.

1. How and where will informed consent be obtained? (e.g., in the clinic, PI’s private office, subject’s home, etc.)
   Informed consent will be obtained from each subject at the University of Toledo within the Biomechanics Research Laboratory prior to testing.
2. When will the potential subjects or their legally authorized representatives initially be approached for consent and by whom?
The subjects will be approached by the primary investigator at the University of Toledo just prior to initial testing.

3. Will there be an opportunity for potential subject to take consent form home to consider the options and to discuss participation with family members. If not, explain why.
All subjects will be offered the opportunity to take the consent form home for review. If the subject elects to do so the initial testing date will be moved back.

4. If subjects are minors or mentally disabled, describe how and by whom permission will be granted?
If the subjects meet the requirements, then consent can/will be granted by one of their parents or their legal guardian.

5. How and by whom will it be determined that the subjects or their legally authorized representatives understand the research project and their rights as participants?
The investigator and co-investigator will ask the subject or their legally authorized representative a set of questions regarding the core concepts of the research and the informed consent. If the subject or the representative answers the questions incorrectly the co-investigator will explain the correct answer and refer the individual to the correct section within the informed consent. When the subject or representative has no more questions and demonstrates an adequate amount of knowledge about the research protocol, risks and benefits, and their rights (via verbally answering a set of questions) the co-investigator will have deemed the individual competent of their rights.

6. Where will the record of consent be stored?
The record of consent will be kept in a locked filing cabinet within the UT Biomechanics Motion Analysis Laboratory.

7. Please list all study personnel that will be obtaining consent.
Rachel K. Smith- co-investigator
Peggy Arnos- primary investigator

PLEASE ATTACH A COPY OF ALL CONSENT/ASSENT FORMS USED IN THE STUDY.

H-2. ALTERATION OR WAIVER OF INFORMED CONSENT

If this research involves patients or patient records, you must complete the Request for Waiver of Authorization for Use and Disclosure of Protected Health Information (PHI) for Purposes of Research. The form can be accessed from the hyperlink above or from the DHRP Biomedical Forms page.

If the research does not involve patients or patient records, please complete the following.
The IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

(1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or

(2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.
If you are requesting a waiver of written consent, please provide justification that either of the two conditions listed above have been met.

*Attach a copy of the cover memo/information sheet that will be distributed to subjects.*

The IRB may waive the requirements to obtain informed consent provided the IRB finds and documents that:

1. the research involves no more than minimal risk to the subjects;
2. the waiver or alteration will not adversely affect the rights and welfare of the subjects;
3. the research could not practicably be carried out without the waiver or alteration; and
4. whenever appropriate, the subjects will be provided with additional pertinent information after participation.

If you are requesting a waiver of the consent requirement, please provide justification that ALL of the four conditions listed above have been met. *(Address each of the four points separately)*

---

### 1. CONFIDENTIALITY

Data include not only paper documents, but also blood samples, tissues, etc.

1. **What methods will be employed to ensure the confidentiality of participation and data?**
   
   All documents with personal identifiers (i.e. subject’s names) will be kept in a locked filing cabinet within the Biomechanics Laboratory and will only be accessed by the primary and co-investigators.

2. **How will data be collected and recorded?**
   
   Data will be collected with video camcorders, paper documents, and with computer software using high speed, 3D cameras. All electronic data will be stored on the hard drive of one of the Biomechanics Laboratory computers.

3. **Where will data be stored during the study and how will it be secured?**
   
   Hard data will be stored in a locked filing cabinet. Electronic data will be stored on the hard drive of one of the Biomechanics Laboratory computers which require a password to access.

4. **Who will have access to the data and/or to the codes?**
   
   The primary investigator and the co-investigator will be the only individuals with access to the data.

5. **If data with identifiers will be released, specify the person(s) or agency to whom this information will be released?**
   
   No data with identifiers will be released. The subjects may request a print out of their personal data.

6. **What will happen to the data when the research is complete? (All study records should be kept a minimum of three years after the completion of the study.)**
   
   The data will be kept for the mandated three year period in the possession of the co-investigator in a locked filing cabinet. After three years and when the documents have been deemed useless by the co-investigator the documents will be destroyed.
J. CONFLICT OF INTEREST

Is there any real or apparent conflict of interest on the part of any study personnel (e.g., stock or stock options, interest in technology, consultant to sponsor)?

Yes ☐  No ☒

If Yes, please explain:

Note, please attached the RSP 310 - UT Faculty/Staff Disclosure of Potential Conflict-of-Interest Form for Un-sponsored Human Research for each study personnel if these forms have not been submitted as part of the contract process of the study.

PLEASE BE SURE TO SIGN ASSURANCE STATEMENTS ON NEXT PAGE
**K. ASSURANCES**

**Principal Investigator's Assurance Statement:**

- I certify that the information provided in this application is complete and accurate.
- I understand that as Principal Investigator, I have the ultimate responsibility for the protection of the rights and welfare of human subjects, and the strict adherence to any study-specific requirements imposed by the IRB.
- I agree to comply with all IRB and Institutional policies and procedures, as well as with all applicable Federal, State, and local laws and regulations regarding the protection of human subjects in research and the conduct of clinical research.
- I also agree to the following:
  1. to accept responsibility for the scientific and ethical conduct of this research study,
  2. to obtain prior approval from the Institutional Review Board before amending or altering the research protocol or implementing changes in the approved consent form, study sites or study personnel, recruitment procedures,
  3. to immediately report to the IRB any serious adverse reactions and/or unanticipated effects on subjects which may occur as a result of this study,
  4. to train study personnel in the proper conduct of human subjects research,
  5. to assure that the personnel approved to explain and obtain consent have read the protocol, understand the study, and are fully knowledgeable of ALL details of the protocol and are able to answer ALL questions from research subjects such as risks and alternative treatments and therapies.
  6. to complete the Continuing Review and Final Report Forms required by the UT IRB,
  7. to adhere to the standards of Good Clinical Practice (GCP)*, developed by the International Conference on Harmonization (ICH).

----------------------------------------
Signature of Principal Investigator Date

----------------------------------------
Printed name of Principal Investigator
Dr. Peggy Arnos

**M. DEPARTMENTAL CHAIR / DEAN ASSURANCE STATEMENT:**

My signature certifies that:

1. I have reviewed this application, and I believe that the benefits of the proposed research outweigh the risks to the study subjects.
2. The Principal Investigator has appropriate training, experience, and expertise to conduct this study.
3. The Principal Investigator has adequate staff and facilities to conduct the project.
4. If I become aware of any factors which have the potential to adversely affect the risk/benefit ratio for study subjects, or any issues that may reflect noncompliance with UT policies, or FDA and OHRP regulations regarding research with human subjects, I will immediately report these to the UT IRB.

----------------------------------------
Signature of Chair/Dean Date

----------------------------------------
Printed name of Chair/Dean

*Note, if the Principal Investigator is the Chair of a Department, the appropriate Dean’s signature is required.*
**Remember:** You may not start your research until you receive a written communication from the UT IRB that your research has received IRB approval. It is **NOT ACCEPTABLE** to assume that since you may not have received any notification from the IRB, that your research has been approved. Do not start your research until you have your approval memo(s) in hand. This is especially important if you must seek approval from more than one IRB.
ADULT RESEARCH SUBJECT INFORMATION AND CONSENT FORM

The Effect of Coaching on Two-Handed Catching Instincts and Developmental Differences in College Aged Females

Principal Investigator: Peggy Arnos, Ph.D.
Other Staff (identified by role): Rachel K. Smith, MPT
Contact Phone number(s): Peggy Arnos (419) 530 – 4351
Rachel K. Smith (614) 271 - 1467

What you should know about this research study:

- The intent of this consent/authorization form is to allow you to read about the purpose, risks, and benefits of this research study. All information in this form will be communicated to you verbally by the research staff as well.

- Routine clinical care is based upon the best-known treatment and is provided with the main goal of helping the individual patient. The main goal of research studies is to gain knowledge that may help future patients.

- There is no guarantee that this research will benefit you; and as with routine care, this research can have side effects that can be serious or minor.

- You have the right to refuse to participate in this research, or agree to participate now and change your mind later.

- If you decide to take part in this research or not, or if you decide to take part now but change your mind later, your decision will not affect your routine care.

- Please review this form carefully. Ask any questions before you make a decision about whether or not you want to take part in this research. If you decide to take part in this research, you may ask any additional questions at any time.

- Your participation in this research is voluntary.
NO TEXT THIS PAGE
PURPOSE (WHY THIS RESEARCH IS BEING DONE)
You are being asked to take part in a research study looking at the affects of high school, varsity-level coaching on hand velocity, acceleration, and body mechanics.

You were selected as someone who may want to take part in this study because you meet the age, health, and gender criteria for subjects to be involved in this research. There will be approximately 20 healthy subjects (10 trained, 10 untrained) involved in this research project. This research will add to a growing body of literature addressing female participation in high school sports and the development sequences of trained and untrained females.

DESCRIPTION OF THE RESEARCH PROCEDURES AND DURATION OF YOUR INVOLVEMENT
If you decide to take part in this study, you will be asked to report to the Biomechanics Motion Analysis Laboratory for one testing session. The purpose of this research study will be to determine hand velocity and acceleration differences as well as developmental sequence differences between trained and untrained, college-aged females. Two handed catching is a common skill performed in high school varsity level softball. The information gained from this research study will used to study the kinematic and kinetic differences between trained and untrained females. This information will hopefully be used as a basis for the importance of upper level sports for the motor developmental sequences in females as well as their reaction speed.

The testing session will entail the following: I. self-paced stretching, II. retroreflective marker application with an adhesive, III. two-handed catching trails, IV. video recording of catching trials. The testing session design will allow you to become familiar with the athletic maneuver of interest, and you will be encouraged to ask as many questions as necessary.

Experimental Procedures;

Subject Data Collection:
A form will be given to you asking for your age, seasons playing the sport (both varsity level and non varsity level), years playing the sport, and position most often played.

Measuring joint position: Your motion will be captured using 8 high speed cameras and two traditional camcorders. The marker array on your extremities will be captured by the cameras and stored within the lab computer. Processing this data will produce joint angles (ankle, knee, and hip, shoulder, elbow, wrist, trunk) for your body.

Two-handed catching protocol: Once you complete three practice trials in each of the three locations, you will be asked to complete a total of five trials in each of the locations for analysis. The catching maneuver will involve both hands catching a ball in the most comfortable motion for you. During these trials, you will be asked to move to the ball. If a ball is tossed outside the designated area, then that attempt will be discarded and not analyzed. If a marker or equipment malfunction occurs, then that attempt will be discarded. In the event of a missed catch on the subject’s behalf, then the data collection will continue with an asterisk denoting it as a failed attempt.

All testing procedures will take no more than 2 hours.

RISKS AND DISCOMFORTS YOU MAY EXPERIENCE IF YOU TAKE PART IN THIS RESEARCH
As with any exercise, there is a very small risk of heart attack. You may stop the test at any time if you feel inclined to do so. After, performing the two-handed catching trials, you may experience soreness 24-48 hours post-testing. This risk is minimal as the catches will be completed at a sub-maximal level.
POSSIBLE BENEFIT TO YOU IF YOU DECIDE TO TAKE PART IN THIS RESEARCH
We cannot promise that you will receive any benefits from this research since this is a basic biomechanics study, and as such, there may not be any direct health-related benefits to be gained by your participation. However, you will learn by observing how theory taught in a college classroom is translated into research and the process of scientific inquiry. If you are interested, the rationale for doing the study as well as the theory and significance of each test and your results from each test will be explained. From this, you will better understand the biomechanics behind catching and the potential biomechanical explanation for the differences between trained and untrained females.

COST TO YOU FOR TAKING PART IN THIS STUDY
There is no cost to you for participating in this study.

PAYMENT OR OTHER COMPENSATION TO YOU FOR TAKING PART IN THIS RESEARCH
If you decide to take part in this research you will NOT receive monetary compensation nor will you receive any “extra credit” for any courses that you are enrolled in at The University of Toledo, unless otherwise specified by your professor.

PAYMENT OR OTHER COMPENSATION TO THE RESEARCH SITE
The University of Toledo is not receiving money or other benefits from the sponsor of this research as reimbursement for conducting the research.

ALTERNATIVE(S) TO TAKING PART IN THIS RESEARCH
Since this research will be conducted on normal, healthy individuals of The University of Toledo and surrounding community and involves perturbation of normal physiological conditions, no reasonable therapeutic alternatives will be available.

CONFIDENTIALITY - (USE AND DISCLOSURE OF YOUR PROTECTED HEALTH INFORMATION)
By agreeing to take part in this research study, you give to The University of Toledo (UT), the Principal Investigator and all personnel associated with this research study your permission to use or disclose health information that can be identified with you that we obtain in connection with this study. We will use this information to for the purpose of conducting the research study as described in the research consent/authorization form.

The information that we will use or disclose includes the data collected as described in the procedures section. We will only use this information for ourselves as part of this research plan. Under some circumstances, the Institutional Review Board and Research and Sponsored Programs of the University of Toledo may review your information for compliance audits. We may also disclose your protected health information when required by law, such as in response to judicial orders.

The University of Toledo is required by law to protect the privacy of your health information, and to use or disclose the information we obtain about you in connection with this research study only as authorized by you in this form. There is a possibility that the information we disclose may be re-disclosed by the persons we give it to, and no longer protected. However, we will encourage any person who receives your information from us to continue to protect and not re-disclose the information.

Your permission for us to use or disclose your protected health information as described in this section is voluntary. However, you will not be allowed to participate in the research study unless you give us your permission to use or disclose your protected health information by signing this document.
Your access to your own protected health information may be denied during the term of the research study, but you can access your information once the research study is completed. You have the right to revoke (cancel) the permission you have given to us to use or disclose your protected health information at any time by giving written notice to Rachel Smith or Peggy Arnos. However, a cancellation will not apply if we have acted with your permission, for example, information that already has been used or disclosed prior to the cancellation. Also, a cancellation will not prevent us from continuing to use and disclose information that was obtained prior to the cancellation as necessary to maintain the integrity of the research study.

Except as noted in the above paragraph, your permission for us to use and disclose your protected health information has no expiration date.

A more complete statement of University of Toledo’s Privacy Practices is set forth in its Joint Notice of Privacy Practices. If you have not already received this Notice, a member of the research team will provide this to you. If you have any further questions concerning privacy, you may contact the University of Toledo’s Privacy Officer at 419-383-3413.

IN THE EVENT OF A RESEARCH-RELATED INJURY
In the event of injury resulting from your taking part in this study, treatment can be obtained at a health care facility of your choice. You should understand that the costs of such treatment will be your responsibility. Financial compensation is not available through The University of Toledo or The University of Toledo Medical Center. By signing this form you are not giving up any of your legal rights as a research subject.

In the event of an injury, contact:

Rachel Smith at 614-271-1467
or
Peggy Arnos at 419-530-4351

VOLUNTARY PARTICIPATION
Taking part in this study is voluntary. You may refuse to participate or discontinue participation at any time without penalty or a loss of benefits to which you are otherwise entitled. If you decide not to participate or to discontinue participation, your decision will not affect your future relations with the University of Toledo or The University of Toledo Medical Center.

NEW FINDINGS
You will be notified of new information that might change your decision to be in this study if any becomes available.

ADDITIONAL ELEMENTS
You listened to a summary of the purposes and procedures of this research project, and you may ask more questions about the study at any time. Your refusal to participate or withdraw from the study will have no effect on your status in The University of Toledo or the Toledo, Ohio community.

CONTINUED ON NEXT PAGE
OFFER TO ANSWER QUESTIONS

Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over. If you have questions regarding the research at any time before, during or after the study, you may contact Rachel Smith 614-271-1467 or Peggy Arnos at 419.530.4351.

If you have questions beyond those answered by the research team or your rights as a research subject or research-related injuries, please feel free to contact the Chairperson of the University of Toledo Biomedical Institutional Review Board at 419-383-6796.

SIGNATURE SECTION (Please read carefully)

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES THAT YOU HAVE READ THE INFORMATION PROVIDED ABOVE, YOU HAVE HAD ALL YOUR QUESTIONS ANSWERED, AND YOU HAVE DECIDED TO TAKE PART IN THIS RESEARCH.

BY SIGNING THIS DOCUMENT YOU AUTHORIZE US TO USE OR DISCLOSE YOUR PROTECTED HEALTH INFORMATION AS DESCRIBED IN THIS FORM.

The date you sign this document to enroll in this study, that is, today’s date, MUST fall between the dates indicated on the approval stamp affixed to the bottom of each page. These dates indicate that this form is valid when you enroll in the study but do not reflect how long you may participate in the study. Each page of this Consent/Authorization Form is stamped to indicate the form’s validity as approved by the UT Biomedical Institutional Review Board (IRB).

<table>
<thead>
<tr>
<th>Name of Subject (please print)</th>
<th>Signature of Subject or Person Authorized to Consent</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship to the Subject (Healthcare Power of Attorney authority or Legal Guardian)</td>
<td>Time</td>
<td>a.m.</td>
</tr>
<tr>
<td>Name of Person Obtaining Consent (please print)</td>
<td>Signature of Person Obtaining Consent</td>
<td>Date</td>
</tr>
<tr>
<td>Name of Witness to Consent Process (when required by ICH Guidelines) (please print)</td>
<td>Signature of Witness to Consent Process (when required by ICH Guidelines)</td>
<td>Date</td>
</tr>
</tbody>
</table>

ASK IF YOU WOULD LIKE A SIGNED COPY OF THIS FORM TO KEEP.
Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Rachel Smith successfully completed the NIH Web-based training course “Protecting Human Research Participants”.

Date of completion: 06/05/2008

Certification Number: 44805
Subject Data Collection Sheet for:

The Effects of Coaching on

Two-Handed Catching Techniques in College Aged Females

Subject’s Number: ____________________________
Subject’s Age: __________
Number of years played of fast-pitched softball: __________
Number of seasons played at a varsity level: __________
Position most often played at a varsity level: __________
### Table 1: Breakdown of components

<table>
<thead>
<tr>
<th></th>
<th>Beginner</th>
<th>Intermediate</th>
<th>Experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Component</td>
<td>Arms outstretched</td>
<td>Some shoulder flexion</td>
<td>Arms relaxed</td>
</tr>
<tr>
<td>Elbow Component</td>
<td>Elbows extended</td>
<td>Flexion at elbows</td>
<td>Flexion at elbows</td>
</tr>
<tr>
<td><strong>Reception</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Component</td>
<td>Arms outstretched</td>
<td>Arm moving upwards</td>
<td>Arms moving downwards</td>
</tr>
<tr>
<td>Elbows ridged</td>
<td>Elbows greatly bent</td>
<td>Elbows slightly bent</td>
<td></td>
</tr>
<tr>
<td>Do not react to ball, thus fail to catch</td>
<td>Trapping motion</td>
<td>Receiving motion</td>
<td></td>
</tr>
<tr>
<td><strong>Hand Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Palms up</td>
<td>Palms facing each other</td>
<td>Palms adjusted to flight path</td>
</tr>
<tr>
<td><strong>Body Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No body adjustment</td>
<td>Arms and trunk in relation to flight path</td>
<td>Move feet, trunk, and arms to flight path</td>
</tr>
<tr>
<td><strong>Feet Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No feet movement</td>
<td>One step movement</td>
<td>Step up and through ball</td>
</tr>
</tbody>
</table>

### Table 2: To Person Breakdown of components (points)

<table>
<thead>
<tr>
<th></th>
<th>Beginner</th>
<th>Intermediate</th>
<th>Experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elbow Component</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Reception</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elbows ridged</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Do not react to ball, thus fail to catch</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Hand Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Body Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Feet Component</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>8</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Table 2: To Person Breakdown of components (points)</td>
<td>Beginner</td>
<td>Intermediate</td>
<td>Experienced</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-----------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Preparation Arm Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elbow Component</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Reception Arm Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Hand Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Body Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feet Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 2: To Person Breakdown of components (points) | Beginner | Intermediate | Experienced |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation Arm Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elbow Component</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Reception Arm Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Hand Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Body Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feet Component</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Subject: ____________________

Trial 1: _____  Point breakdown: ________________________
Trial 2: _____  Point breakdown: ________________________
Trial 3: _____  Point breakdown: ________________________
Trial 4: _____  Point breakdown: ________________________
Trial 5: _____  Point breakdown: ________________________

Total Points:   _____

Average points: _____

Trial 6: _____  Point breakdown: ________________________
Trial 7: _____  Point breakdown: ________________________
Trial 8: _____  Point breakdown: ________________________
Trial 9: _____  Point breakdown: ________________________
Trial 10: _____  Point breakdown: ________________________

Total Points:   _____

Average points: _____

Trial 11: _____  Point breakdown: ________________________
Trial 12: _____  Point breakdown: ________________________
Trial 13: _____  Point breakdown: ________________________
Trial 14: _____  Point breakdown: ________________________
Trial 15: _____  Point breakdown: ________________________

Total Points:   _____

Average points: _____
Subjects needed for:
The Effect of Coaching on Two-Handed Catching Instincts in College-Aged Females
(both softball players and non softball players are needed)

Conducted by Rachel K. Smith
Department: Kinesiology

What: Participants will be videoed while catching some gentle tosses utilizing a tennis balls.
How long will this take: This study takes about one hour

To participate please email Rachel.Smith@utoledo.edu
    > If you have participated in three years of varsity level softball, please put “Catching Research: Experienced” in the subject heading.
    > If you have no softball experience, please put “Catching Research: No Experience” in the subject heading.

Inclusion Criteria: Females between the ages of 18-22 who are healthy
Subjects are needed who have either participated in a minimum of 3 years Varsity level softball or have never participated in softball at any level.

Exclusion Material: Subjects will be excluded from participating who have: known musculoskeletal disease, cardiorespiratory disease, nervous system disorders, and/or upper or lower extremity surgeries and fractures; are pregnant; or have any neurological or cardiorespiratory disorder with the exception of mild to moderate asthma.

There will be no charge or compensation for participation in this study, only my sincere thanks!

College of Health and Human Service Department of Kinesiology
2801 W. Bancroft St. Toledo, OH 43606