Performance & Motor Control
Characteristics of Functional Skill

• Part III: Throwing, Catching & Hitting
Throwing
Interesting Facts

Studies indicate that boys move across the stages at a faster rate than girls which means there are large gender differences in throwing development. Overarm throw is usually study by measuring the distance, accuracy, and velocity of one’s throw. In all of the above measures boys are better than girls even with more and more girls being afforded the opportunity to partake in skilled motor practice. Of all the motor skills throwing performance was found to have the greatest gender difference.
Accounting for Gender Differences

Heredity or Sociocultural Factors were to determine to be the causes.
Heredity

Nelson and colleagues (1986) measuring boy’s and girl’s joint diameters, shoulder/hip ratio, forearm length, and arm and leg muscle mass, determined that girls improvement in throwing was only 69% of that of boys.

Nelson et al (1991) indicated that arm muscle mass was a major player in throwing distance.

Girls who weighted more and had greater arm and leg muscles than smaller and weaker girls threw farther but still lagged behind boys.
Sociocultural Factor

Carlton (1989) concluded that the best predictor for throwing development in girls was their participation in sport, movement programs and the presence of an older brother in the household.

The best predictor for throwing development in boys was father’s sport involvement and father-son play.
Factors that Affect Throwing

Halverson and associates (1977 & 1979) studied the effects of instruction on overarm throwing:

- Instruction did not improve kindergarten children's ball-throwing velocities.
- Instruction did improve kindergarten throwing techniques.
Instruction & Overarm Throwing Development

Giving instruction about throwing components of stride length, arm retraction, side facing, trunk rotation, arm patterns, and stride opposition.

- Stride length was the only component that improved (Luedke, 1980).

Walkwitz (1989) indicated that throwing pattern development does not correspond to greater throwing distance in girls.
Three critical learning cues have been identified to develop overarm throwing:

- Take a long step toward the target with the opposite foot of your throwing arm.
- Take your arm straight down, then stretch it way back to make an “L” with the arm.
- Watch the target and release the ball when you see your fingers (Fronske & colleagues, 1997)
Stride Length in Throwing
Factors that Affect Throwing

Ball Size

- Ball size and hand size width has an important relationship to throwing
- Researchers have found that as ball diameter increases and as hand size decreases throwing becomes less mature.
Factors that Affect Throwing

Angle of release

- Angle of release is related to throwing distance

- Mature angle of releases can be facilitated by manipulating ball weight and size (Burton and Colleagues, 1993)
Factors that Affect Throwing

Does improvement in one’s technique affect throwing velocity?

Longitudinal data over a 7 year period by Roberton and Konczak (2001) found that developmental sequence of the overhand throw accounted for 65 to 85% of ball-throwing velocity.

Increasing one’s stride length accounted for the greatest increase in ball-throwing velocity.
Overarm Throw

- Preparatory Phase
- Execution Phase
- Follow-through Phase
Wild’s (1938) Developmental Overarm Throwing Stages

- Stage 1: Lack of any preparatory backswing of the throwing arm.
- Stage 2: The ball is brought up beside the head by upward humerus flexion and exaggerated elbow flexion.
- Stage 3: Simple vertical lift of throwing arm.
- Stage 4: Circular arm action in which the arm moves down and back
Overhand Throw
Throwing

Teachable Points
- Eyes are focused on the target
- Ball is held at the base of the fingers
- Weight transference by stepping forward with foot opposite the throwing arm
- Arm extension is evident
- Wrist is cocked at the back of the wind-up
- Throw starts with hip rotating toward the target and then the shoulders follow.

Teachable Points
- Arm moves forward, it bends approximately 90 degrees.
- Ball is released in front of the body
- Wrist snaps downward
- Follow-through toward target, then down, and past leg.
Catching

Action of bringing an airborne object under control by using the hands and arms.

There has been little research into developmental stages of catching.
Vision & Catching

Catching
1) Involves a moving object
2) Grasping the ball is the end movement of catching

Prehension
1) Involves a stationary object
2) Prehension involves manipulation of the object
Three Phases of Catching an Object

On initial ball flight, no arm action is seen.
About 25 to 80% of ball flight, elbow flexion and finger extension occurs slowly.
At about 50% to time the ball is caught, the hand withdraw and become spatially positioned.
Shortly before the catch, fingers become positioned.

*Successful catchers had their hands and fingers ready to catch the ball earlier than unsuccessful catchers.*
VISION AND CATCHING

• Visual contact is needed during the initial part of flight and period of time just prior to contact with the hand(s)
  – Only the first 300 ms of flight is needed to determine direction & distance.
  – Only the last 200-300 ms before hand contact is critical.

• Viewing the object between these two time periods is not critical to catching

• Performers visually sample the ball flight characteristics (snap shots every 80s of ball flight) to obtain up-to-date information about when they need to catch the ball

• Optical variable tau (time to contact) is involved in solving the time to contact problem in catching
  – An approach object visual size increases (looming) which the visual system uses to determine when collision with the object will occur.
  – An approaching object off the left or right of the body, TAU controls the timing of the reach to catch the object
DOES ONE NEED TO SEE THEIR HANDS TO CATCH AN OBJECT?

• Smyth & Marriott study of seeing or not seeing their hands..
  – Seeing their hands were more accurate
  – All catchers were able to make correct spatial position of their hands to intercept the ball

• Experience in catching is an important factor
  – Experienced catchers do not need to see their hand.
  – Lowly skill catcher do need to see their hands throughout the flight
Catching

Preparation: Arm Component
Reception: Arm Component
Hand Component
Body component
Interesting Fact about Catching

Developmental characteristics of catching relates to the development of the visuoperceptual system ability to predict the object’s flight characteristics.

The ability to predict the object’s flight characteristics is usually not developed until around the age of 15 with extensive practice.

The first attempt to catch occurred when as a infant we blocked a rolled object.

Fear of the projectile is a conditioned response from earlier failures at the task.

Catching with one’s hands is the most advanced level of catching development.
Interesting Facts About Catching

At the present time, studies have not found conclusively if boys develop faster than girls or girls develop faster than boys.

Location of the tossed ball is an important factor in one and two handed catching.
Factors that Influence Catching Performance

Ball size
- A smaller ball elicits a more mature hand catch than an arm/chest trap.
- As ball size increased, the maturity level of catching regressed.

Ball color and background color
- Preferred ball color influence catching
- Blue and yellow balls were caught significantly better than white ball.
- Background is an important factor (contrast sensitivity)
Factor Affecting Catching

Instruction

-To date only one studies has been conducted about instruction and catching.
- Williams (1992) trained 8 year old boy on 7 successive days for 30 minutes.
- Significant changes were observed in number of successful catches.
Factors that influence Catching Performance

Ball speed
  Catching performances decline as speed of the ball increases. Is there a threshold?

Trajectory angle
  Project the ball in a ark or implement higher for all around better catching.

Viewing time
  As viewing time decreases, one ability to retain the projectile decreases.
Catching

Balls projected directly toward the person is easier to catch than moving to a new location to catch the ball (Keegan, 1989)

Avoid pairing up an inexperienced thrower with a inexperienced catcher.

Using a glove improves catching success.

Using a new glove or one that is too large hinders catching.
Vision & Hitting

- Ball viewing or tracking occurs with two systems
  - Image-retina system
    - reads the image of the ball as it washes across the retina
    - Eyes & head do not move
    - Use when viewing the object is short (245 ms or faster)
  - Eye-in-head system
    - Eyes and head move to track the ball
    - Image is maintained on fovea longer
    - Used when viewing the object last 365 ms or longer.

- Both systems are available to provide information about the object but the transition (shifting) between two systems is long (120ms)

- Earlier tracking using eye-in-head system is therefore preferred
Vision & Hitting

• Experienced hitters can correctly identify all the pitches (89%) where as inexperienced hitters cannot (60%).

• Novice hitter fixate at the head of the pitcher where as elite hitters fixated on the release point of the pitcher.

• Novices tended to saccade before the release of the ball where experienced hitters waited until after the release of the ball
VISION AND HITTING

1. One can see the ball only to the point at which the swing is made (Hubbard & Seng) not to the point of contact.

2. Success in hitting or striking is related to tau-base strategies:
   - Batters synchronize the start of their step to release of the ball.
   - Successful hitter’s duration of the swing to swing was consistent from one swing to another.
   - Initiations of the swing was adjusted according to the speed of the oncoming pitch.
   - Successful hitters use the same visual tracking pattern and had a consistent stance to prepare for the pitch.
   - Less Head movement (less than 1 degree) during the swing across all types of pitches is another factor to successful hitting.
   - All adjustments and decision to swing is triggered by visual information (TAU) that occurs in the first 500 msec of ball flight
   - Last 2/3 of ball flight the striker can only make slight racquet or bat changes
Visual Training

• Experimental evidence is lacking about the effectiveness of general vision training to improve sport performances
  – Sport Vision
  – Eyerobics

• Many common visual functions do improve but research has found that Visual ability is sport specific.
  – Visual training exercises should be sport specific.
Hitting

Inexperienced
• NO step but if a step is present it is with the homolateral leg.
• Up-down striking motion
• Little backswing with striking arm or implement
• Trunk and hips do not rotate
• There is no blocking of the hip action.
• Arms are rigid with little wrist snap when swing

Experienced
• Forward step with foot opposite the striking arm or striking side.
• Striker uses a full backswing
• Striker swings the striking implement horizontally
• Hip then trunk rotation (differentiated)
• Arms are relaxed and noticeable wrist snap when swinging the bat or implement
The End