PERFORMANCE & DEVELOPMENT OF CHARACTERISTICS OF COMPLEX SKILLS
Specific characteristics of the performance of various skills provide the basis for much of our understanding of the process involved in motor control and development.
PREHENSION

• Act of grasping which includes the approach (reach), grasp, and releasing the object.

• Prehension is different from the action of reaching and pointing to an object (aiming skill)

• Motor control issues
  – Each component of prehension (reach, grasp, & release) are separate movements but function in an independent manner.

continued
Prehension

• Very important skill that enables the infant to interact with their environment because it involves manipulation of objects
• Baby’s initial attempt to reach, grasp, and manipulate a object is an extremely important sign of motor development
• First sign of voluntary reach and grasp is around 4 months of age
• Reach and grasp seems to appears simultaneously
Prehension

- Prehension applies to speed accuracy trade-off, that is, the time of prehension is affected by distance of the reach and size of object.
  - Jakobson & Goodale (1991) indicated that object’s size and distance from the hand influenced the timing of the grasp and velocity of the reach.
  - Regardless of the object size and distance, hand closure occurred at approximately 2/3rds of the total movement time of the action (Chiefi & Gentilucci, 1993).
  - Intended grasp of the object and visual information about the distance to the object, size, shape, weight, etc., is preset to initiate the reach and grasp. When the arm begins to move toward the object, modification to the reach, grasp, and release is controlled by vision (if there is sufficient time).
Prehension

• Speed-Accuracy Trade Off

• Fitt’s Law provide a mathematical model
  – $MT = a + b \log_2(2D/W)$
  – Variables that predict performance is distance to move and target size

• Fitt’s law has an index that measures the difficulty of the task (ID’s)
Prehension

• Phase I Reaching & Grasping
  – One-handed reaching
  – Reaching is visually initiated, that is the child reach when they see an object.
  – Once the child makes manual contact with the object, vision facilitates hand closure (grasp)
    • Child decides when to grasp based on what they visually perceive.
Prehension

• Phase II Reaching and Grasping
  – Once the reach has been completed, the child attempts different types of grasps (differentiation)
  – Infant uses two hands to acquire an external object
  – Reach is visually initiated and visually controlled (that is they can use vision to correct their reach)
  – The role of vision in grasp to close the hand diminishes become tactile stimulated.
Prehension

The infant at an early age does not need to see their hand and the target in early reaching and grasping activities but the efficiency in their reach and grasp is enhanced if viewing their own hands.

- Clifton et al. (1993) videotaping infants reach for a rattle or glowing object in light and dark environments
Prehension

Development from Phase I to Phase II reach and grasp
- 4 months prehension is controlled by the shoulders and arms; incapable of making contact with the object
- 5 months prehension is controlled by wrist, hand, and finger control; plus thumb in opposition to the fingers; crude contact with object
- 6 months a squeeze grasp emerges (fingers close around the object.
- 9 months prehension can be controlled by thumb and one finger (pincerlike control); fingertips of the 3 fingers oppose the action of the thumb in the grasp
- 13 months fingers oppose the action of the thumb without hand being stabilized
- 18 months the child can finally easily release the object
Prehension

Halverson (1931) classic study of prehension found that there was three basic and progressive methods of reaching.

1. Sweeping the hand and arm in a backhand manner toward the object
2. Scooping the hand and arm from different angles.
3. Direct reach
Prehension

Development of the prehension is proximodistal

According the Halverson prehension occurs in predictable evolving stages with increasing age.

But recent research by Newell et al. (1989) indicated that one to two hand grasping and differentiation of the object size is related to the child’s object-to-hand-size ratio, that is, if the object were scaled to the subject hand size it occurs the grasp is similar to an adult pattern as early as the age of 6-7 years old.
Prehension

Continues to develop throughout the first decade of life.

- Trajectory and magnitude of fingers opening
- We open our hand wider with experience
- At 1 year of age, grasping and reaching development is related to walking, that is, two-hand grasping becomes more pronounced on all reaching tasks at the time the child begins to walk.

What does this say about retraining one’s walk after a stroke or disease in physical therapy?
Prehension

How can we refine and train prehension?

- In the beginning repeat the grasp and reach with the same familiar object (shape, size, and weight) this develops the ability to differentiate between objects and improve the one’s anticipation of weight, force, and velocity of prehension.

- Then vary sizes, shapes, and weight of the objects and require different reaching and grasping techniques in light and dark environments.

- Realize that one’s control of the rate of speed of their grasp and force of the grasp in the beginning of retraining is negatively associated but with practice becomes similar (Pare & Dugas, 1999).

- Provide functional (real life tasks) that involve reaching, grasping, and object manipulation.