ACTION PREPARATION
Performing voluntary, coordinated movements requires preparation of the motor control
Action Preparation Requires Time

This chapter is devoted to:

“the principle that the motor control system needs preparation before it can initiate an action.”

RT (reaction time) is an index of preparation required to produce an action which is sometimes called response-delay interval.
Factors that influence action preparation

- Task & situational characteristics that can influence one’s reaction time.
- Performance characteristics that influence one’s reaction time.
TASK & SITUATIONAL CHARACTERISTICS

- Number of responses choices
- Predictability of the correct response choice
- Influence of pre-cueing
- Stimulus response compatibility
- Fore period length regularity
- Movement complexity
- Movement accuracy
- Repetition of a movement
- Psychological refractory period
NUMBER OF RESPONSE CHOICES

- Hick’s Law
- Predicts that RT increases as the number of choices alternatives increases
- Predicts the size of increases to be expected
Apply Hick’s Law to Sport

- Time out where the coach give instruction to their players about an upcoming play.

- Hockey player skating down the ice during a game, he or she has several choices
PREDICTABILITY OF THE CORRECT RESPONSE CHOICE

- As the predictability of one of the possible choices increases, RT decreases.

- It’s all about probability of advanced information being correct!
  - 50-50 chance: Chance of guessing is low!
  - 80-20 chance: Bias effect will occur
  - 20-80 chance: Bias effect will occur.
Precueing Technique

- Precueing technique provides performer with advanced information and as the number of precueing dimensions increases so does RT increase BUT:
  - If advanced knowledge of what will happen is correct, precueing will work to the advantage of the performer.
  - If advanced knowledge of what will happen is incorrect, precueing will work to the disadvantage of the performer.
Precueing & Sport

Why does an end around play in football work sometimes and other times it does not work?

- The answer is found in the cost-benefit-trade off principle
Research Evidence

- Research evidence has consistently shown that as the predictability of one of the possible choices increases, reaction time decreases. A popular way to investigate this assumption is through the pre-cueing technique. Pre-cueing technique is where the researcher provide the participant with differing amounts of advanced information about which movement must be made in a choice situation. Prior to the signal to move, the subject receives advance information (the pre-cue) specifying the correct upcoming response. Researchers using the pre-cue technique have indicated that correct advanced information given to the subject prior to the “go” signal improves their preparation time.

- An interesting twist to the pre-cue situation occurs when the advanced information may or may not be correct. The critical factor influencing the preparation time in this situation is the probability of the advance information correctness. It has been determined that subjects who are in a two choice situation (the advanced information has only a 50-50 chance of being correct), the subject will ignore the information and respond as if no advanced information has been given. But if the advanced information has an 80 percent chance of being correct or wrong, the performer will bias his or her preparation in making a response.
STIMULUS RESPONSE COMPATIBILITY

- RT decreases (faster) as the relationship between the stimulus and their required response becomes compatible.

- RT increases (slows) as when this relationship become less compatible.
Before you even turn on a burner which stove will enables you to make a faster decision?
Stimulus-response compatibility

- Stroop effect...appearance of the stimulus suggests one type of response but the situation requires a difference response.

- Spatial relation
  - 5 on floor to steering column shifting
  - Circus dash board to car dash panel
FOREPERIOD LENGTH
REGULARITY

Time period between the warning signal and the go signal.

What happens to our decisions when:
- When there is no foreperiod?
- When foreperiod varies?
- When foreperiod is constant?
MOVEMENT COMPLEXITY

- RT increases as the task become more complicated due to motor program theory (more parts to control).

- Key factor is the number of component parts involved in the action.
MOVEMENT ACCURACY

- As the movement demands for movement increases, the greater the amount of preparation time is required.
THE REPETITION OF A MOVEMENT

- What affect does practicing a motor or sport skill have on one’s reaction time?

- WHY?
PSYCHOLOGICAL REFRACTORY PERIOD (PRP)

RT delay to second response is called PRP
PRP is the delay period during which a planned response seems to put on hold another response
TASK & SITUATIONAL CHARACTERISTICS SUMMARY

Teacher, coach, exercise specialist, and/or PT can increase one preparation action (be slower) when:

- One increases the number of movement alternatives
- One increases the unpredictability of the correct movement response alternative
- Pre-cue information is incorrect
- Increase the degree of spatial incompatibility between the situation and movement outcome
- Increase the irregularity of the foreperiod
- Having no previous practice in performing the task
Part II: Performer Characteristics
PERFORMER CHARACTERISTICS

- Alertness of the performer
- Attentional Focus
ALERTNESS OF THE PERFORMER

- Optimal length of being alert is key factor in reaction time tasks.
- Different tasks
  - One type of RT task, where a person does not have to wait for any length of period beyond a few seconds but must respond as quickly and possible.
  - One type of RT task, where a person has a long term maintenance of alertness (vigilance tasks) where signal occurs very infrequently or irregularly..
Alertness and RT

- Types of tasks with a short optimal time of alertness, RT are smaller than tasks with a long optimal time of alertness.
- Fast reaction time usually occur when the performer’s fore period length ranges from 1 to 4 seconds.
- When the stimulus is irregular or one has to wait long periods before the stimulus appears, RT is slow.
Alertness & Injury

- Closed-head injury
  - Boxers
  - Car accident resulting in brain damage
  - Football player with repeated concussions.

- Problems
  - Duration of being vigilant is short
  - RT increases in detection of the stimulus (detection time latency)
ATTENTIONAL FOCUS

- Should we have the performer concentrate on the start signal (sensory set) or the required movement?
- When one’s focus is on the sensory set it produces faster RT than the motor response.
Performer characteristic (summary)

- The teacher, coach, exercise specialist or PT can increase action preparation time (be slower) by:
  - Decreasing the performer’s alertness
  - Focus on one’s movement rather than the “go” signal
WHAT OCCURS DURING PREPARATION?

- Postural preparation
- Preparing the limb to move in a given direction, trajectory and accuracy.
- Preparing one for object control
- Preparing for skills that require sequences
- Preparing one to move in a specific pattern
- Preparing to move in rhythmic pattern
What occurs during preparation?

Fractionated Reaction Time
Insight into Preparation

If we increase response complexity, we see an increase in pre motor component.

If we increase duration of completing the response increases, we see an increase in premotor component.

If movement velocity increases, we see an increase in premotor component.

If I perform the skill with more force, we see an increase in both premotor and motor components.
Developmental Coordination Disorder

Children who display motor performance levels below those of aged-matched peers.

Fractionated visual RT revealed the DCD children’s reaction times are slower in both their pre- and motor components.

These results gave researchers evidence that motor component (motor time) contributes to coordination difficulties.
Postural Preparation

- Prior to performing a task, postural muscles are activated to prepare for movement (anticipatory postural adjustment)
  - In elbow-flexion aiming task, muscles of both legs were activated before the arm muscles.
  - Prior to a leg movement, muscles that stabilized the leg fired before the prime movers.
- Stoke patients with paralysis on one side (hemiparesis) have problems because they are impaired in anticipatory postural adjustments.
Some Interesting Facts about Preparation

- EMG studies prove there is relationship between movement time and postural position.
- One feature of limb movement a person must prepare is the direction in which the limb must move, especially for ballistic skills.
- A common problem with stroke patients is inability to perform anticipatory postural adjustment of the trunk & limbs.
- Movement force characteristics in lifting an object must occurs in advance involving manipulating the object.
- The precision of limb positioning will be greater and faster when a person’s limb is in a comfortable position (end-state comfort control)
Some interesting facts about preparation (continued)

- Hand positioning in playing piano and typing is key to playing or typing because the skills are sequential.
- Pre-performance routines stabilizes the motor system
  - Southard and Amos with tennis serve found a .77 correlation between relative time of a ritual to successful performance.
  - Mack found additional evidence of ritual in free-throw shooting.
Preparation & Training

- Position of player’s limb or body prior to movement is key to being successful.
- Get the player or client ready for performing by having a “readiness position.”
- Develop pre performance routines
The End